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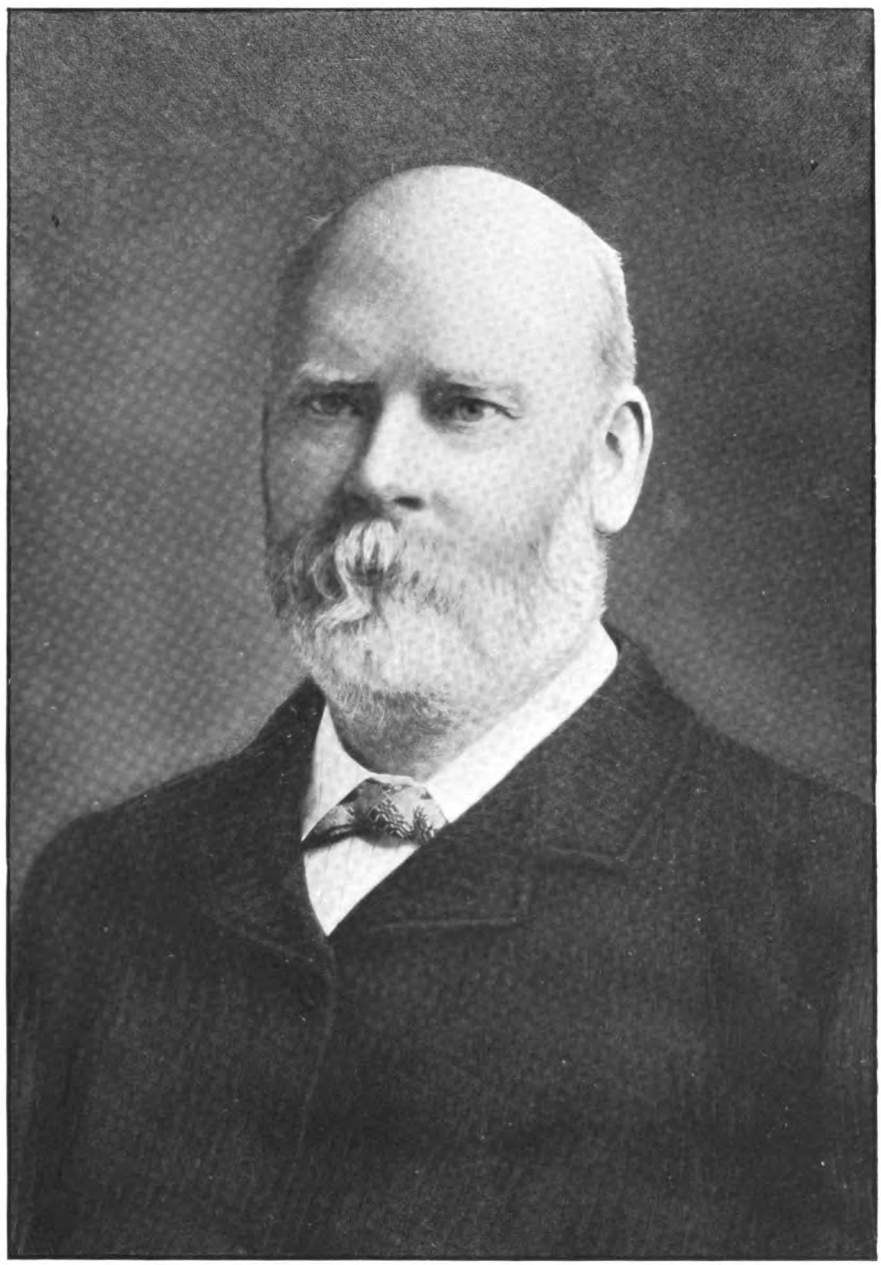

P. W. Haslam

CASSELL'S

CYCLOPÆDIA OF MECHANICS

CONTAINING

RECEIPTS, PROCESSES, AND MEMORANDA FOR WORKSHOP USE

BASED ON PERSONAL EXPERIENCE AND EXPERT KNOWLEDGE

PAUL N. HASLUCK

EDITOR-IN-CHIEF

Volume I

FIRST EDITION

CASSELL AND COMPANY, LIMITED

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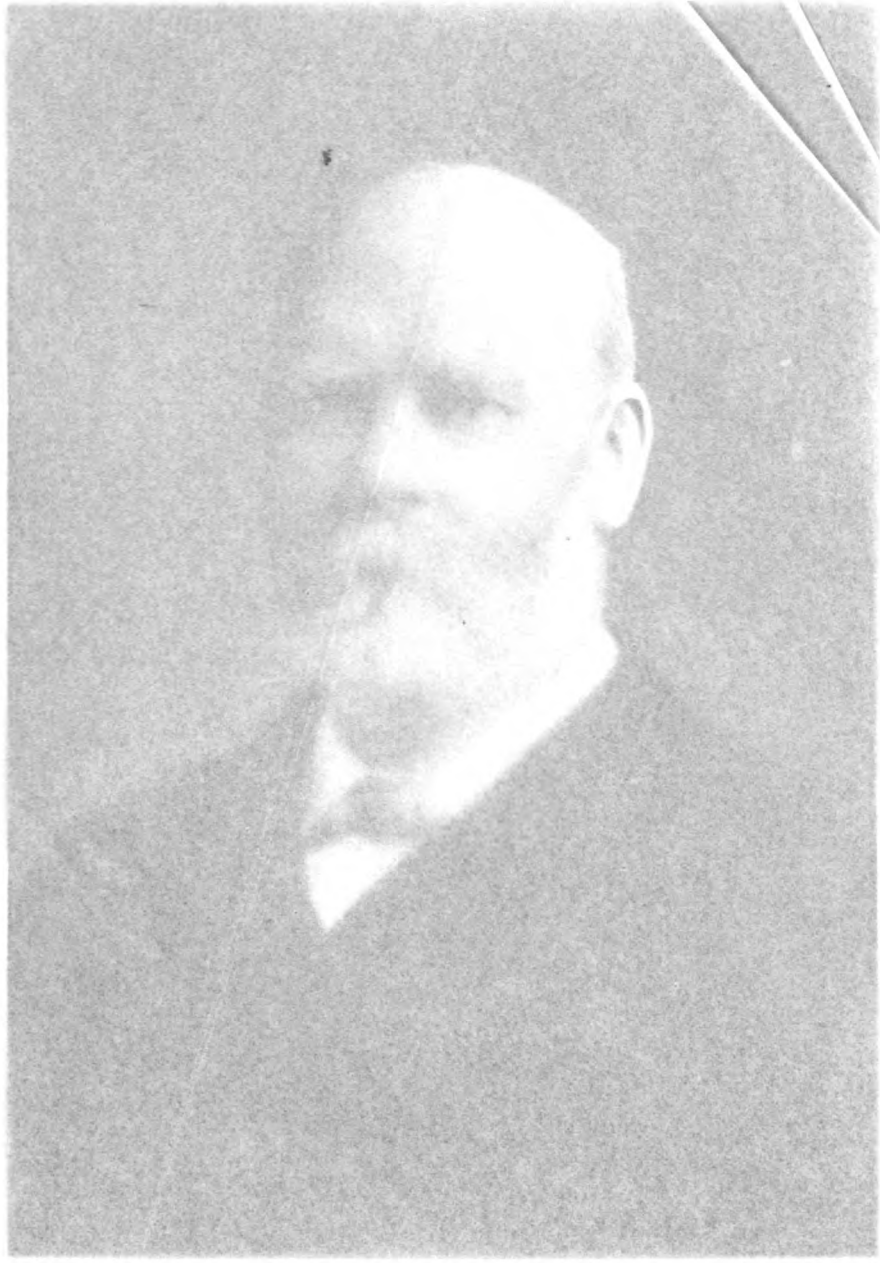

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PREFACE.

CASSELL'S CYCLOPÆDIA OF MECHANICS contains in a form convenient for ready reference and everyday use receipts, processes, and memoranda selected from a rich store of choice information contributed by a staff of skilful and talented technicians, upon whose practical experience and expert knowledge the information is based. The matter contained in these volumes has been carefully digested, freely illustrated, and made plain to those inexperienced.

All compilations of receipts and memoranda for the use of mechanics that have been published—and some have attained great popularity—differ from the present series in the important fact that almost every item in these volumes is the paid contribution of an expert, written specially to satisfy the want of an inquirer, and each has challenged emendation from a wide circle of practical men. Corrective and supplementary matter supplied by these critical readers has been incorporated to ensure the greater efficiency of this work.

A superficial glance through the pages of these volumes might tend to a false impression that the varied contents are not readily available for easy and systematic reference. However, this is not so. Experience has shown that it is not possible to classify paragraphs that often include matters essentially different so that there shall be a definite place for every item, and the impossibility of such a course is particularly emphasised in the present collection, which embraces subjects widely diversified. Even a little consideration of this Cyclopædia would show that no possible arrangement of the paragraphs would place them so that the several facts contained in each could be found with ease and certainty. The copious indexes provide a means by which every separate particular and detail of any kind dealt with in these volumes may be traced and referred to with the least amount of trouble. These indexes also bring together all references to the same subject, however widely they may be scattered, and all varied notes included under one heading are properly analysed and, thus disclosed, regrouped with kindred topics. No pains have been spared in the compilation of this index, which efficiently serves

a purpose impossible to be met by any arrangement of paragraphs comprising the volume.

Amongst the items embodied in this work probably every reader can find some that contain information already known to him. Possibly some readers may be able to supplement the particulars given in respect of matters with which they are familiar. Any authentic supplementary particulars that are likely to be of benefit and that would increase the usefulness of the information will be welcomed, and should be sent to the undersigned.

P. N. HASLUCK.

La Belle Sauvage,
London.

INDEX TO ILLUSTRATIONS TO VOLUMES I. AND II.

LIST OF PLATES (VOL. I.)

SUBJECTS DEALT WITH IN VOLUMES I. AND II.

(Illustrated Subjects are denoted by Asterisks.)

H

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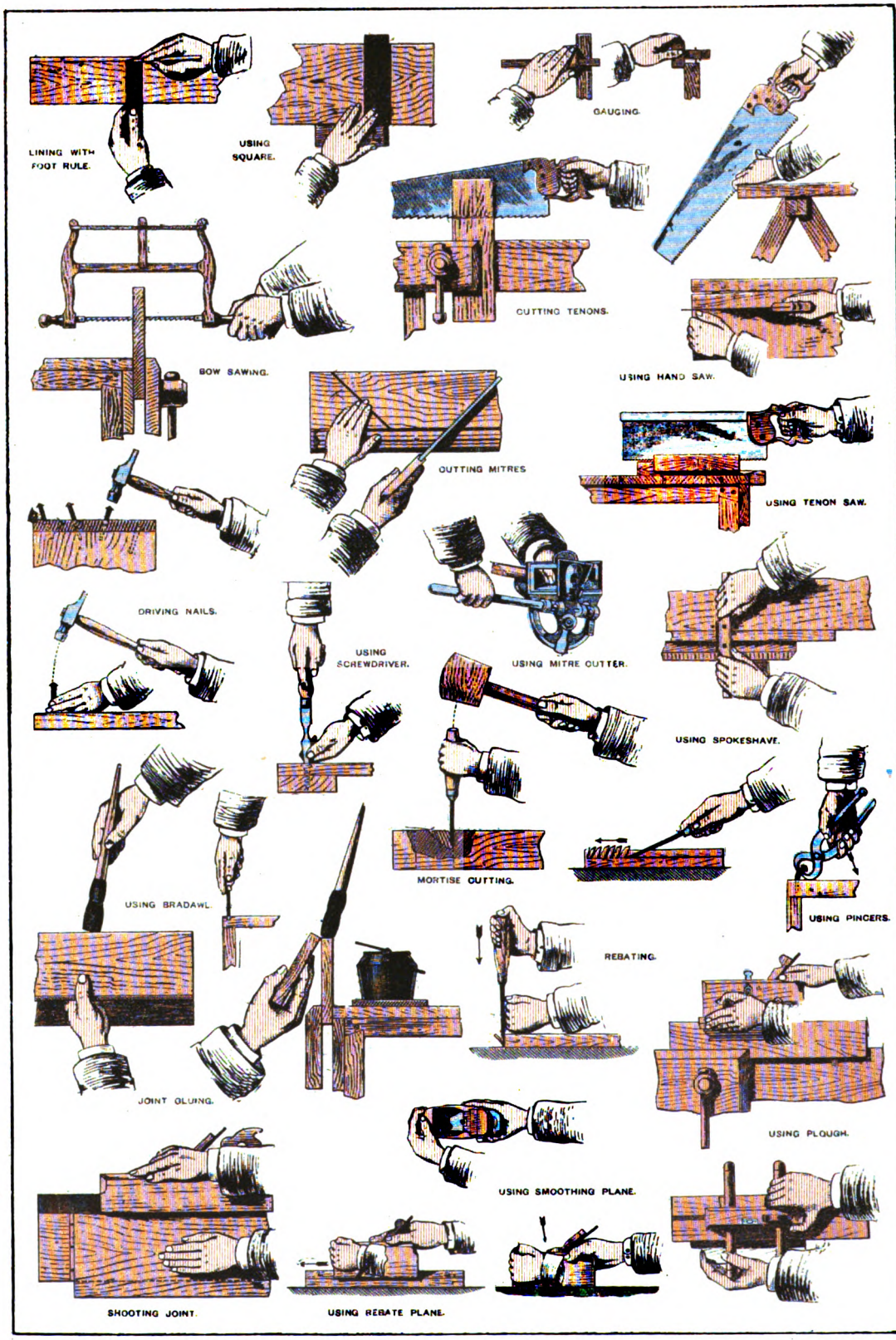
V

MANIPULATION OF TOOLS



Refilling Fitzroy Barometer.—It is not an easy matter for an inexperienced person to fill a barometer properly. The tube and mercury must first be made warm. The mercury may be heated to the boiling point of water in an iron vessel; a vessel having tin in its composition must on no account be used. The glass should be warmed sufficiently to ensure the evaporation of all moisture. Make a paper funnel having but a very small aperture and pour in the mercury, whose impurities will cling to the paper funnel, and test for correct amount with a standard barometer. Be careful that air does not enter with the mercury. If an odd air-bubble appears, send up a little more to collect, and send up to the top what has already entered.

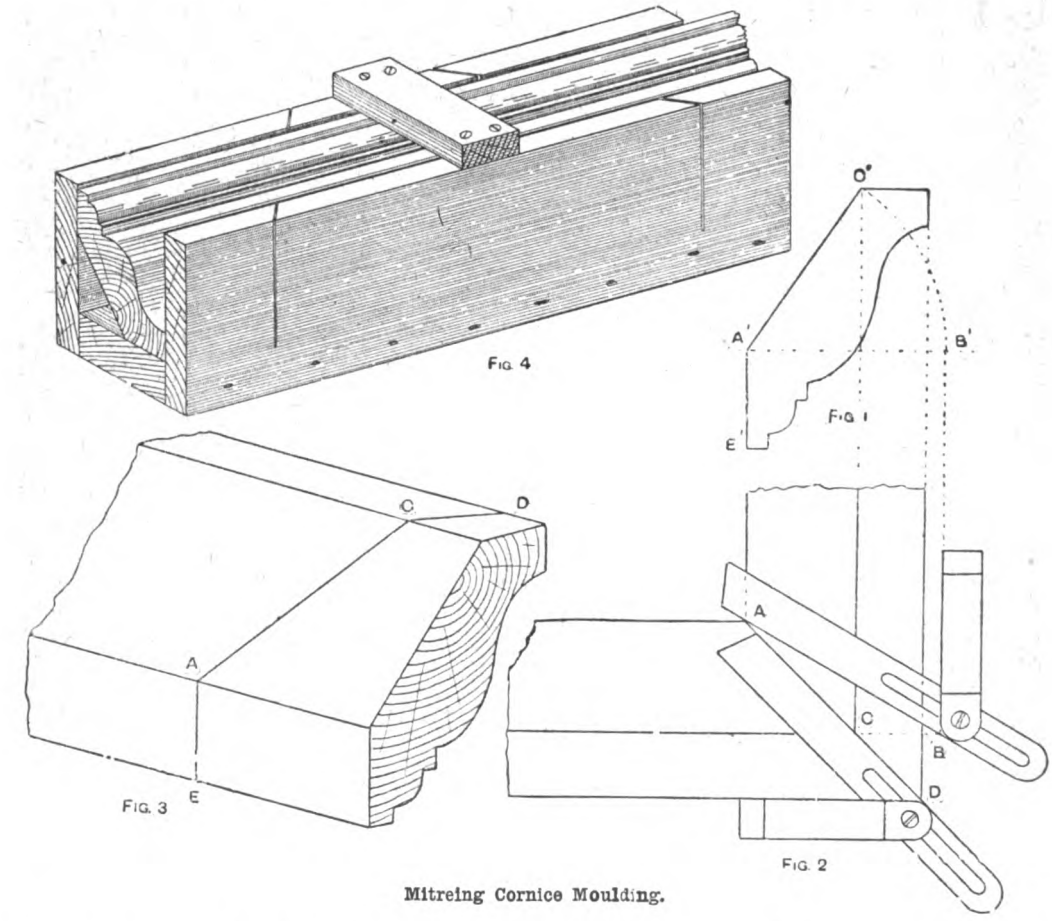
Making Lantern Slides.—Lantern slides are made from prints, photographs, etc., in the following way. Make a negative of the subject by copying in the camera in the usual way. Focus the picture sharply within a square 3¼ in. by 3¼ in., leaving ¼ in. each way for binding and masking. Copying is merely photographing at close quarters. If the camera will not extend far enough to obtain a picture of the required size, the lens and front can be removed from the camera proper, and the camera lengthened by attaching to it a box at one end of which the lens and front can be fitted, the join between the box and the camera being covered with a dark cloth. From the negative thus obtained a lantern slide may be made either by contact or through the camera. Making slides by contact is the simpler plan if the lantern plate is large enough to contain the whole of the picture. Place the lantern plate in contact with the negative (film to film) in the dark room and expose to the light of a gas flame; a thin image is developed. Bromide plates are the least troublesome to use, and a simple developer is metol and soda. After development, the plate is fixed and washed as usual. When the negative is dry a mask is laid on the film side, and over the mask is placed a carefully cleaned cover glass; the two glasses are then bound together with strips of black gummed paper. The glasses should be gripped firmly in the centre with the thumb and forefinger of the left hand, and the moistened paper laid along the top edge in position and smoothed gently towards the two ends. When dry, do the opposite side, then the remaining sides. Lastly, clean off any gum and finger marks. For copying through the camera, the negative should be fixed in the bottom of the box, glass side out (so that the sides of the box shade the film), and either placed on a slanting board pointing to the clear sky, or set up on a table in front of a lamp shaded with a sheet of ground glass. The picture is then focussed to the desired size, and the exposure is made by daylight, if possible, or by artificial light, such as a lamp or a piece of magnesium ribbon burnt behind ground glass. Masks can be bought; they are used to define the extent of the picture to be shown on the screen. The cover glass protects the film of the negative. The binding strips can also be bought; their use is obvious. A white spot (a small circular piece of white paper) is placed in each of the top corners of the negative as a guide to the lantern operator. When photographs or book prints are to be copied on to slides the grain of the paper may be got rid of by wetting the print or photograph and squeegeeing it on to clean glass, carefully stroking out the air bubbles between the print and the glass. If it is not desirable to wet the photograph it may be put in a printing frame with glass before it and then exposed before the camera. A line drawing may be copied the same size by coating a piece of glass 3¼ in. by 3¼ in. with a weak solution of gelatine. The glass should be placed over the design and a tracing made on the gelatine film with pen and ink (Stephens' ebony stain answers well). When very fine lines are required the film may be rubbed with medium and a retouching pencil used. This tracing can be used as a lantern plate. The masking, binding, and fixing of the cover glass are described above.

Making Socket Joint in Steam Pipe.—The proportions for a cement for the socket joint of a steam pipe are, by weight, 1 part of powdered sal-ammoniac, 2 parts of flour sulphur, and 80 to 100 parts of borings; the borings should be pounded if large. These ingredients must be well mixed and moistened with water, and will be ready for use in from one to two hours. Caulk the socket two-thirds full of yarn, and finish with one-third of borings. The less borings used the better, for a slight expansive action occurs in the borings when setting, and this causes the splitting of sockets. If there are only one or two joints, get some white lead and add sufficient dry red lead to make a stiff putty; thin a little of this with boiled oil, and paint inside the socket first. Then caulk in alternate layers of yarn and putty, commencing with the yarn and finishing with the putty. This cement is longer in setting than the former one.

Etching on Steel.—All processes of steel etching depend on the coating of the steel with a resist, which is scraped away from those portions to be etched or bitten into by chemical action. The resist or etching ground is made by melting together over a slow fire black pitch, white wax, Burgundy pitch, asphaltum, and gum mastic. Other etching grounds are (1) asphaltum varnish; (2) yellow beeswax dissolved in turpentine and continuously decanted until no sediment remains—to 6 parts of this add 1 part of japan varnish; (3) asphaltum, Burgundy pitch, and beeswax melted together. The resist may either be melted and then brushed on, or the steel may be warmed so that on rubbing it with the resist the latter will melt and leave a thin film. The resist is allowed to become cold and hard, and is then drawn on with needles or, preferably, with a stick of steel of ¼-in. diameter round or square section tapering to a fine point at each end; the weight of this tool is sufficient to penetrate and remove the resist as it is drawn along, thus leaving the hand more at liberty to draw freely or form letters as the case may be. If the steel is in the form of a plate, it now has a wall of wax built around its edges, and into the shallow dish thus formed the etching acid is poured. Knife blades and similar small articles having been properly coated with resist, may be dipped into the acid, or the latter may be applied to the portions to be etched by means of a camel-hair pencil or a stick, at the end of which is mounted a little ball of tissue-paper. Remember that all portions not covered with the resist will be etched. The etching acid may be any of the following mixtures. (1) Pyroligneous acid, nitric acid, and water; (2) diluted nitrous acid; (3) 2oz. of copper sulphate, ½ oz. of alum, ½ oz. of salt, ½ pt. of vinegar, and 40 drops of nitric acid; (4) 4 parts of glacial acetic acid and 1 part of absolute alcohol; allow to remain for thirty minutes, and add gradually 1 part of nitric acid; (5) 1 part of fuming hydrochloric acid and 7 parts of water; add boiling solution of potassium chlorate and dilute with water. When the acid has bitten sufficiently deep, pour it off or remove it, and wash thoroughly in clean water. If it is required to etch more deeply certain portions, cover up the rest with a stopping ground of lampblack and Venice turpentine, or with any of the above etching grounds, and apply the acid again. When the etching is complete, wash off all traces of acid.

Dyeing Pampas Grass.—To dye pampas grass, place it in fairly strong solutions of aniline dyes, and heat until sufficiently coloured. The most suitable dyes are soluble blue, picric acid, fast yellow, eosine, magenta, methyl violet, malachite green, Bismarck brown, and acid brown. If, however, only small quantities are to be dyed, use Judson's or other dyes, which may be obtained in packets.

Mitreing Cornice Moulding.—In marking off the ends of two pieces of cornice moulding which are to be joined at right angles, the procedure is as follows. Let the section of the moulding be as shown in Fig. 1. Draw the plan of the mouldings and mitre as



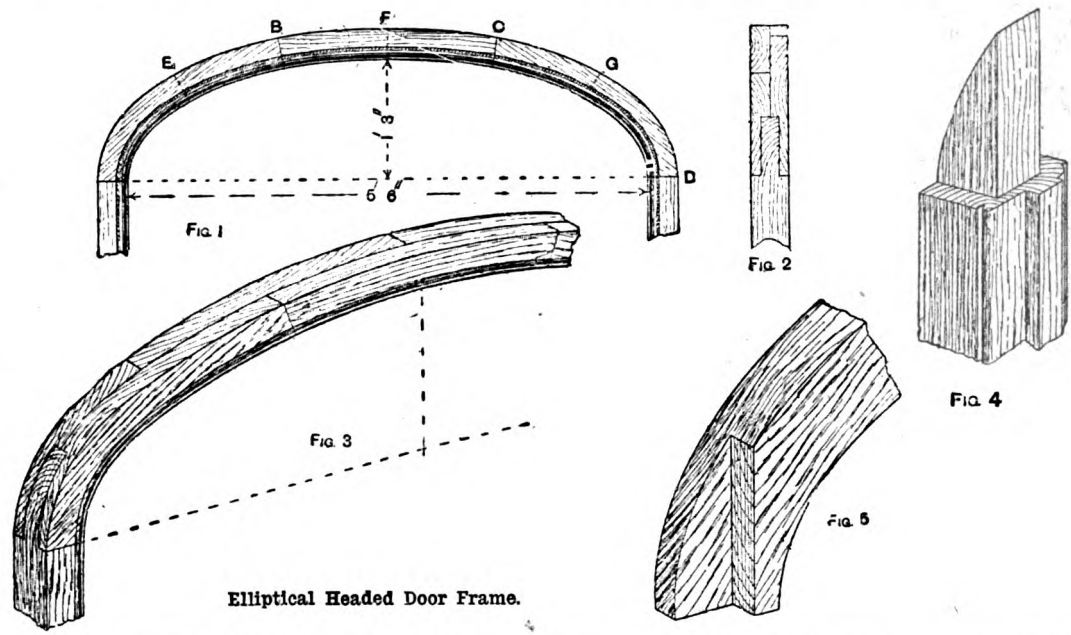
Mitreing Cornice Moulding.

at Fig. 2. Then set a bevel to the mitre line C D. This will be the bevel to apply to the top edge, as indicated by the line C D (Fig. 3). For the bevel for the sloping back, through the angle at A′ (Fig. 1) draw A′ B′. With A′ as centre and C′ as radius, draw the arc C′ B′. Now draw B′ B parallel to the lines in the plan, as shown, and C B parallel to A′ B′; then join B to A. Set the bevel as indicated, and apply it to the sloping back of the moulding and mark it. This will give a line as indicated by A C (Fig. 3). As A′ E′ is a vertical surface, the line A E indicated at Fig. 3 can be drawn square. This principle can be applied for mouldings meeting at any angle. If there are several mitres to be made and all meet at the same angle, a simpler plan, and one that will save much time, is to construct a mitre box which will hold the moulding to the exact angle, as shown at Fig. 4, and the mitres can be cut in the manner illustrated and described on p. 136.

Painting Railway Wagons.—The first or priming coat on railway wagons is made of tub white lead, raw linseed oil, patent driers, a little common black, and turpentine. The quantities may be best judged by experience, but the following will serve as a guide. Put 10 lb. of white lead, 1 qt. of raw linseed oil, and about ¼ lb. of patent driers in a large pot and mix well together, adding sufficient black to produce the desired tint. Strain through a piece of canvas and add just sufficient turps to make the paint work smoothly. The quantity of driers will vary according to the state of the surface to be painted and the quality of the material. The tint used must be made to accord with the finishing colour. For instance, if a light colour is desired, the priming and following coats must be light, so as gradually to lead to the finishing tint. For the second coat, the same colour may be used as for the first. For the third coat, oxide red, linseed oil, and terebine as a drier may be used. For the fourth coat, half oxide paint and half varnish may be used. For dead colours, the dry paint is ground in turpentine; a little gold size and varnish are then added and the paint thinned down to a working consistency with turps. Boiled oil may be used if desired with the finishing coats. It is necessary to remember, however, that only very small quantities of boiled oil should be used if the best results are to be gained in finishing. Either terebine or gold size may be used as driers with delicate tints such as would be injured by using patent driers. Copal varnish may be mixed with the finishing coats, or it may be used by itself as a finishing coat over the last coat of colour. The materials used will vary according to the finishing tint. For instance, a blue wagon would be finished as follows. The priming coat would be lead colour, rather dark, as described above; the second coat would be the same with a little blue mixed in; third coat, ultramarine or Prussian blue as a dead colour; fourth coat, the same, with half its bulk of varnish. The writing and picking out would then be put on with two coats of dead colour, the last coat being clear varnish. The usual practice is simply to paint with three coats of lead colour.

Blackening Aluminium.—The bronze known in the trade as "arsenic bronze," diluted with an equal quantity of water, is used for blackening aluminium. First the exposed parts of the surface should be curled, not straight-grained, with emery-paper; then the metal should be quickly dipped into the fluid and as sharply withdrawn, and drained. If on the first immersion the bronze has not taken well all over, the process should be repeated. If the preparation is too strong, there is a danger that the acid will eat away the metal. A recipe for arsenic bronze is hydrochloric acid, 12 lb.; sulphate of iron, 1 lb.; pure white arsenic, 1 lb. To this, for aluminium, must be added an equal quantity of water; and, when the metal has blackened, it should be dried in a mixture of blacklead and sawdust. Only sufficient sawdust is required to soak up the moisture. The exposed parts then may be lacquered.

Elliptical Headed Door Frame.—In commencing to set out and construct an elliptical headed door frame, width 5 ft. 6 in., rise 1 ft. 3 in. inside measurement, to be made in two thicknesses of 2½-in. and 2-in. stuff screwed together, first set out the head full size on a board as shown in Fig. 1. A mould should be made for half the inside thickness, and one for the outer thickness; from these moulds the stuff should be marked out. It will be seen from the drawing that the outer part of the head is made of three pieces—that is, from A to B, B to C, and C to D; the inside is constructed of four pieces—from A to E, E to F, F to G, and G to D. The direction of the grain for the outside pieces is indicated in the illustrations. The connection between the head pieces and the posts is fully shown by Figs. 2 to 5, as also the general construction of the head. It will be a stronger job if the pieces are glued as well as screwed together.



Elliptical Headed Door Frame.

Chemists' Show Bottles.—For an *amber-coloured* liquid for use in chemists' show bottles, dissolve 1 part of coarsely powdered dragon's blood in 4 parts of oil of vitriol, and dilute with cold distilled water. *Blue* liquid may be a diluted solution of (*a*) 1 oz. of copper sulphate in ¼ oz. of sulphuric acid, (*b*) soluble Prussian blue in oxalic acid, or (*c*) indigo in sulphuric acid. *Crimson* liquid is a diluted solution of 30 gr. each of iodide of potash and iodine in 1 dr. of water; or an infusion of 1 oz. of alkanet root in 20 oz. of turpentine. For *green*, (*a*) dissolve 1 dr. of copper sulphate and 30 gr. of bichromate of potash in 2 oz. of liquid ammonia, and add 1 gal. of water; (*b*) dissolve 2 oz. of copper sulphate and 4 oz. of sodium chloride in 1 pt. of water; (*c*) dissolve distilled verdigris in acetic acid and dilute with water; or (*d*) dissolve blue vitriol in water and add nitric acid until of the right tint. For *magenta*, dissolve acetate of rosaniline in water. *Orange-coloured* liquid is (*a*) a solution of bichromate of potash in water to which is then added a little sulphuric acid, or (*b*) a dilute solution of gamboge in liquor of potassa. For *pink*, add to a solution of cobalt nitrate or cobalt chloride sufficient sesquicarbonate of ammonia to dissolve the precipitate first formed. For *purple*, (*a*) mix a solution of 2 dr. of sulphate of copper in 2 oz. of water with a solution of 1 dr. of French gelatine in 2 oz. of boiling water, and add 2 pt. of liquor of potassa; shake a few times during ten hours, decant, and dilute with water; (*b*) dissolve 1 oz. of copper sulphate in 1 qt. of water, and add 1½ oz. of sesquicarbonate of ammonia; (*c*) add sufficient carbonate of ammonia to an infusion of logwood; (*d*) dissolve 3 oz. of lead acetate and 1 dr. of cochineal in sufficient water; or (*e*) add sulphate of indigo, nearly neutralised with chalk, to an infusion of cochineal. For *red*, (*a*) dissolve 10 gr. of sulphocyanide of potassium to 1 gal. of water, and add 10 drops of a solution of perchloride of iron; (*b*) dissolve carmine in ammonia and dilute with water; (*c*) dissolve cochineal in a weak solution of ammonia; (*d*) dissolve madder lake in sesquicarbonate of ammonia and dilute with water; or (*e*) dissolve cochineal in sal-ammoniac and dilute with water. For *violet*, mix together solutions of nitrate of cobalt and sesquicarbonate of ammonia, and add sufficient ammonio-sulphate of copper. For *yellow*, (*a*) dissolve 1 lb. of sesquioxide of iron in 2 qt. of hydrochloric acid, and dilute with water; (*b*) add a little alum to a strong decoction of French berries; (*c*) dissolve either the chromate or bichromate of potassium in water; or (*d*) dissolve equal parts of nitre and potassium chromate in water. *Multi-coloured* or *variegated* show bottles are formed by employing a number of liquids having different specific gravities and different colours. Pour in the following solutions in the order mentioned, using a funnel and allowing the stream to fall upon a floating cork. (1) Chemically pure sulphuric acid tinted blue with indigo sulphate, (2) chemically pure and untinted chloroform, (3) glycerine tinted brown with caramel (burnt sugar), (4) castor oil tinted red with alkanet root, (5) 40 per cent. alcohol tinted green with aniline colour, (6) cod liver oil containing 1 per cent. of oil of turpentine, and (7) 94 per cent. alcohol tinted with aniline violet.

Precautions in Making White French Polish.—To protect the shellac from atmospheric influences it should, when at the merchant's, be stored in water; neglect of this precaution causes the shellac to lose its nature, and it will not then dissolve by simple immersion. The lac, when purchased, should be at once broken up small, spread on clean paper, and set aside in a warm, not hot, place, and frequently turned over till it feels quite dry. It should then be placed with the spirit in a stone or earthenware pickle jar, over the top of which a piece of rag should be tied. Then set the jar in a saucepan partly filled with water, glue-pot fashion, and place in an oven or on a gas or oil stove, and gradually bring up to blood heat. If the lac does not then dissolve, it should be thrown away as worthless.

Polishing Curling Stones.—As a rule, curling stones are made of granite or trap, a mixture of felspar and hornblende; therefore to polish them without machinery is very laborious work. Rig up a vertical lathe similar to those used by lapidaries, and place the stone on it, and, while revolving, put coarse emery and water on it, pressing a piece of smooth iron on the stone as it revolves. When all pits and unevennesses are removed, carefully wash away the emery grains and go through the same process with fine emery, removing all scratches left by the former treatment. This process must be gone through with care, as if scratches are not removed it will be impossible to get a good polish. When an even grain, dull polish is obtained, carefully wash again, removing all traces of emery. Fasten a piece of felt to a piece of wood and on it put some putty powder slightly wetted, and apply to the stone until a good polish is obtained. A deal of the rough work might be done in bringing the stones into condition for further grinding if in the first instance they could be slung in front of a grindstone.

Vignetting Photographs.—If it is required to make a vignette photograph without showing much dark around the head and neck proceed thus. Cut in cardboard (old plate boxes answer well) a vignette considerably smaller than the desired vignette G (Figs. 1 and 2), and fix about ¾ in. from the negative by fastening with drawing pins. To do this, it may be necessary to nail some strips of wood B around the outer edges of the printing frame. Fig. 1 shows a perspective view and

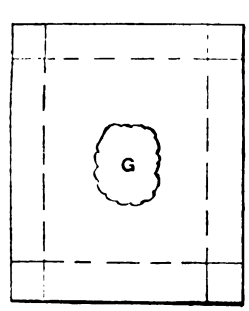
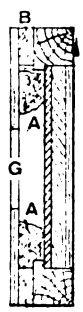


FIG. 1



B FIG 2

Vignetting Photographs.

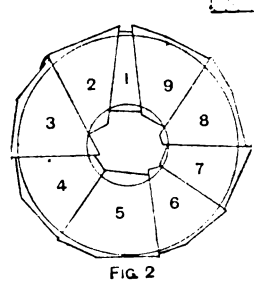


FIG. 2

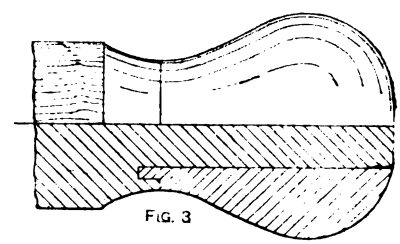


FIG. 3

Making a Wood Chuck in Sections.

Fig. 2 a section of the vignetted frame. Cover with cotton-wool A any thin portions of the negative coming near the margins—such as may occur with a black coat—or the light will creep too far and the shape of the vignette be spoilt. The wool must be pulled out very loose and soft, or a hard line will be shown by the shadow it casts on the negative. In cases where the negative is very thin it is advisable to cover the vignette with tissue paper. Vignettes should always be printed in subdued light. A vignette card must not be cut too closely around the figure, nor its outline repeated too decidedly, as the effect thus obtained will be quite as inartistic as the stereotyped egg shaped patch. To produce a successful vignette, a light background must be used. With a dark background it is all but impossible to get a soft vignette. The farther the hole is from the plate and the darker the background of the negative, the larger will the vignette be, and the softer will be its outline. During early attempts at vignetting the print should be examined from time to time to see that the vignette is going on satisfactorily.

Straightening Brass Curtain Poles.—To straighten a brass curtain pole that has been used for a bay window, first anneal the tube where bent, then load it with lead and, after cooling, pass it through a hole in a firmly fixed bench until the shoulder of the bend rests against the shoulder of the hole. Then pull the tube until it is quite straight against the wood shoulder. Finally, melt out the lead and repolish and lacquer the tube. When lacquering the tube, first gently heat it, then apply with a brush an even coat of lacquer, and stand it aside free from dust until dry.

Making Taps for Watch Screw Threads.—Taps for watch screw threads may be made from needles, but probably they would not last long. A tap should be made from the best steel; therefore get a length of tool steel wire of the correct size. From this cut off a suitable length, say 1½ in. Soften it by heating to a dull red and allowing it to cool slowly. Hold it in a pin-vice and, resting it on a piece of boxwood, file it to a gentle taper until the end just enters the hole in a screw-plate; the wire may then be screwed into the latter, plenty of oil being used. When it goes hard, turn it back half a turn, then forward three-quarters of a turn, back half a turn again, and so on, advancing slowly until a full thread is cut for a sufficient distance. Then file three flats upon it for the whole length of the thread, tapering the flats to the end, where they should meet in a knife edge and show only half a full thread. Harden the tap by heating to a red colour and plunging in cold water. Brighten one flat and heat it over a flame until it is of a pale straw colour. This renders it less brittle, and is called "tempering." Then carefully smooth all three flats on an oilstone so as to leave good cutting edges. Finally, file some nicks in the soft end to indicate the number of the hole in the screw-plate to which it belongs.

Making a Wood Chuck in Sections.—A section chuck in wood, suitable for spinning a silver jug in the lathe, may be made in this way. Fix a piece of hornbeam of the requisite size on the mandrel and turn it to the shape of Fig. 1; A B is the height of the jug, C D the diameter at its

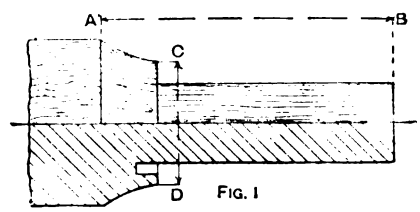


FIG. 1

narrowest point, and A C the profile of its upper part. The diameter of the long cylindrical part C B should be as large as possible without weakening the chuck. Next join a number of wedge-shaped pieces of hornbeam, as shown in Fig. 2; one of the wedges marked 1 should be so shaped that its broadest part turns away from the outside, while the opposite is the case with the other wedges. The joints must be perfect, and are best finished on their joining surfaces with a toothed plane, being so glued together that a piece of brown paper is inserted between each pair of wooden surfaces. Join 1, 2, 3, 4, and 5 together; next 6, 7, 8, and 9. It will now be seen that if the free surfaces of 1 and 5, and 6 and 9, are lying in one plane, the last joining will be fairly easy to accomplish. The better plan is to make a drawing, plan down the shape of the wedges, and work accordingly. When all are joined and dry, chuck the roughly cylindrical piece; bore it out, and turn a ring on one end which will fit nicely in the annular recess shown at D (Fig. 1), the cylindrical part C B fitting tightly in the hole bored without forcing the wedges from one another. When this is accomplished, the chuck can be finished to template as Fig. 3. Now separate the wedges, first marking them with lead pencil so as to secure their proper positions. Remove the loose part of the chuck, insert a thin knife blade in any of the glued joints, and tap gently with a mallet on the back of the knife. The wedges, owing to the brown paper inserted between them, can easily be separated; these nine wedges, when placed on the fixed part of the chuck in their proper rotation, will appear like one single piece. When the metal has been spun home and is removed from the lathe, it is evident that all the wedges are inside the bowl of the jug; but when this is released from the fixed part of the chuck, piece 1 (Fig. 2) can be pushed towards the centre and drops out, the other pieces following. Take care that none of the wedges are of larger transverse dimensions than will permit of them passing easily through the narrowest part of the jug's neck; a drawing of the sections should be made before joining them together.

Determining Grate Area, etc., of Vertical Boilers.—To determine the grate area of a vertical boiler, take the diameter of the firebox at the bottom of the firehole and obtain the area. For instance, in a boiler 6 ft. 6 in. high by 3 ft. diameter, the firebox at the bottom is 2 ft. 5¼ in. At the firebar level, however, this diameter is about 1¼ in. less, viz., 2 ft. 4 in. The area of circle of this diameter = 615·75 sq. in. = 4·27 sq. ft., which is the area of the grate. To obtain the approximate heating surface, multiply the grate area by 10, the ratio of heating surface to grate surface in these boilers being about 10 to 1. Thus, the heating surface in the boiler in question = 4·27 × 10 = 42·7 sq. ft. An approximate rule for the horse-power is to allow 10 sq. ft. of heating surface per horse-power.

Cutting Figured Boards from Pitch-pine Logs.—Some hints are given here on sawing up a pitch-pine log so as to get the best variety in the figuring of wood to be used for panels. It must be remembered that the amount of figure in a pitch-pine log depends on the amount of irregularity of growth in the tree. Curly figured pitch-pine cannot be got out of a plain pitch-pine log. But even the plainest log will afford a good amount of passable figure with judicious handling. In the accompanying illustrations, which treat only of plain logs, the outer board A (Fig. 1) will have a large and open figure, approximating to the type shown in Fig. 4, and so also would the outer boards on the three other sides of the same log. From A to B the figure narrows down considerably

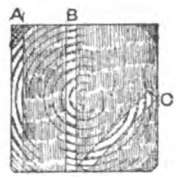


FIG. 1

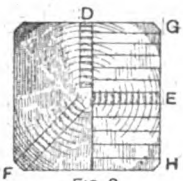


FIG. 2


FIG. 3


FIG. 4

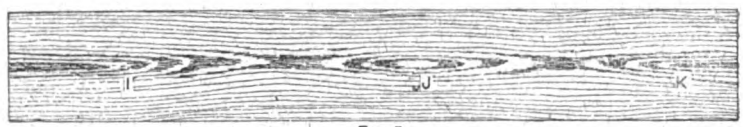


FIG. 5


FIG. 6

Cutting Figured Boards from Pitch-pine Logs.

it is lost altogether, the board E being shown in Fig. 6. The reverses of figure shown at I, J, and K (Fig. 5) are due to slight bends that occurred in the growing tree—the saw, in its straight course, revealing outcrops of lower layers of wood. The figure on any given side of a log may also be varied within certain limits by first cutting a long wedge-shaped slab off the side and then making all subsequent boards parallel (in thickness) to the newly exposed surface. Closeness of ring will also affect the figure to some extent; but these circumstances do not interfere with the general principle just given.

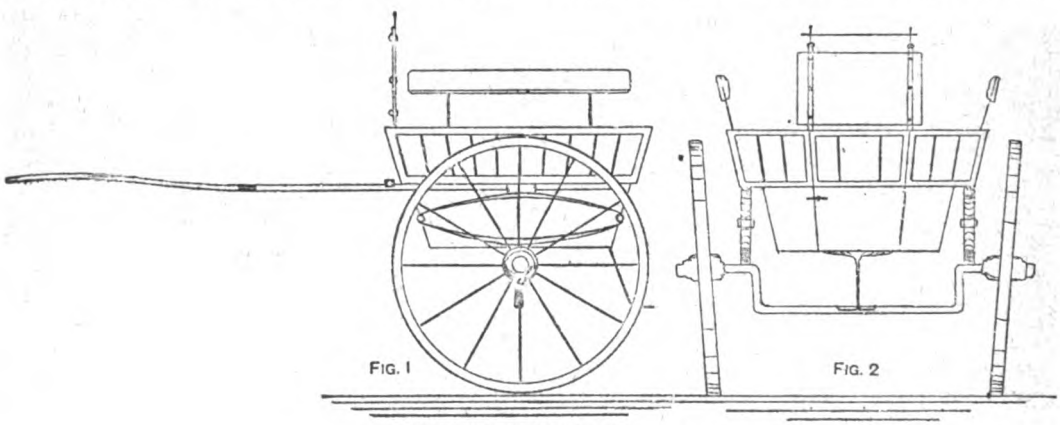
Recipes for Bottle-capping Mixtures or Waxes.—The following recipes are for waxes and mixtures for use in sealing bottles. (1) Soak 7 lb. of good gelatine in 10 oz. of glycerine and 60 oz. of water and heat over a water bath until dissolved; the mixture can be coloured by the addition of pigments, and various tints can be obtained by the use of aniline colours. The resulting compound should be stored in jars. To apply, heat the mass to a liquid and dip in it the cork and portions of the neck of the bottle; it sets very quickly. (2) Mix 1 oz. of gelatine, 1 oz. of gum arabic, and 20 gr. of boric acid with 14 fluid oz. of cold water. Stir occasionally until the gum is dissolved. Heat the mixture to boiling point, remove the scum, and strain. Then stir in a mixture of 1 oz. of starch and 2 fluid oz. of water until a uniform product results. As in the former recipe, the composition may be tinted with any suitable dye. Before using it must be softened by the application of heat. (3) Dissolve 3 oz. of shellac, 1½ oz. of Venice turpentine, and 72 gr. of boric acid in a mixture of 12½ fluid oz. of alcohol and 6 fluid drachms of ether, colour with a spirit-soluble dye, and add 3 oz. of powdered talcum. During use the mixture must be agitated frequently. (4) For a black bottle wax, melt together equal parts of common resin, pitch, and ivory black. (5) Another, melt together 20 lb. of common resin, 5 lb. of tallow, and 4 lb. of lampblack. (6) For a red bottle wax, mix together by the aid of heat 15 lb. of common resin, 4 lb. of tallow, and 5 lb. of red lead. (7) Melt together 6 oz. of resin, 2 oz. of shellac, and 2 oz. of Venice turpentine, and add 9 oz. of lampblack or other colouring matter. (8) Red: Melt together 6½ parts of resin, ½ part of beeswax, and 1½ parts of Venetian red or red lead. (9) Red: Use 4 oz. of shellac, 1 oz. Venetian turpentine, and 3 oz. vermilion. Melt the lac in a copper pan suspended over a clear charcoal fire, and pour the Venice turpentine slowly into it, finally adding the vermilion, stirring briskly the while. (10) Melt 2 lb. of shellac and 4 lb. of resin cautiously in a bright copper pan over a clear charcoal fire. When melted, add 2½ lb. of Venice turpentine and 1½ lb. of red-lead. Pour into moulds, or form sticks on a warm marble plate. Gloss may be produced by polishing the sticks with a rag until they are cold. (11) The following recipe is recommended by Sheirer: Heat 2 parts of Burgundy pitch until all the water is driven off, add 1 part of turpentine and 4 parts of colophony, and when the whole is liquid thoroughly mix it with 2 parts of chalk, ½ part of carbonate of magnesia, and 2 parts of Armenian bole.

Making Coloured Crayons.—Coloured crayons may be made by mixing pipeclay with water to form a stiff dough. The material may be made harder by adding a little soap to the water. For a blue colour, add common

until when the position B is reached the amount and proportion of the figure will be approximately as shown in Fig. 5. The figure in all the boards will be symmetrical—that is to say, its climax, or turning point, will be at the centre of every board. All will, therefore, be suitable for panels. The symmetry of figure is due to the position of each board, relatively to the annual rings of the log. Each board is tangentially situated, the point of contact being near the centre of its width. Thus, the board C (Fig. 1), while inclined at a different angle to the boards A and B, will still have the same kind of figure on its face—for the reason that it is situated tangentially to the rings. Boards cut on the radii of the tree, as D and E (Fig. 2), will have no flower figure, and except for the presence of an occasional knot or two, perhaps, will have little of an ornamental character on their surfaces, excepting, of course, the straight or wavy lines that represent the edges of the yearly layers of wood (see Fig. 6). Here again the board F (Fig. 2) is disposed diagonally to D and E, but the figures will be the same, for all are situated on radii of the tree. To secure the greatest amount of figure out of any given log, it is therefore necessary to cut as many boards as possible tangentially to the rings. In Fig. 3, for example, each board will be ornamentally figured, and the width of the figure will be proportionate to the width of the board throughout. It is unfortunate that in securing this result the boards will vary so greatly in width. The sketch is given here only as an extreme example of a means to an end. In Fig. 2 the boards G and H are practically halves of the board A (Fig. 1), and the figure in these will therefore be like the upper and lower half respectively of the board shown in Fig. 4. From G and H, in towards E, the figure at the inner edges of the intermediate boards becomes less and less prominent, until when E is reached

ultramarine; for red, use venetian red; for brown, use umber or vandyke brown; and for black, use lampblack. After standing two or three days it may be made into balls, rolled into rods between two boards, then cut up into lengths and dried, first in the air and finally in a warm place.

Trap or Tub for 13-Hands Pony.—Fig. 1 is a side elevation and Fig. 2 a back elevation drawn to a scale of ½ in. to 1 ft. of a tub or trap suitable for a 13-hands pony. The length on the seat is 3 ft. 3 in.; length of top rail, 3 ft. 9 in.; depth of well, 11 in.; depth above seat, 9 in.; length of bottom, 2 ft. 6 in.; width, 2 ft. 2½ in. Greater sail is given to the sides so that the top of the vehicle is quite square. Walnut should be used for the well if to be finished in plain varnish. If the frame bottom be of ash, a pair of fence routers for rabbeting on sides and bottom will be required. Or the trap can be put together by rabbeting the ends and using 1-in. deal boards for the bottom, which can be nailed to battens running along the bottom of the sides. The seat boards are of birch 12 in. wide, screwed on top of the well; or the seats may be all framed together similar to the bottom. The four corner pillars and top rails are 1½ in. by 1½ in. The sticks are of ash, ½ in. square, finished black, the stained mahogany panels being screwed on inside. The wheels are 3 ft. 6 in.; stocks, 6½ in. diameter by 7 in. long. Front hoop, 4 in. inside diameter by 2 in. wide; hind hoop, 5 in. diameter by 1 in. wide; spokes, 1½ in.; felloes (cut from 2-in. ash plank) to finish about 1¾ in. square on thickest part; tyres, 1¼ in wide. The wings are 3 ft. 1 in. by 6½ in. by ¼ in., and the raised backs 3 ft. 1 in. by 4 in. by 1 in. The wing irons should be fastened on underneath raised backs, and have 7 in. clearance of the wheels. The elliptic springs are 3 ft. 1 in. between centres of eyes and have five plates 1½ in. wide. The shafts are fastened under the seats, and are 5 ft. 5 in. long in front of splinter bar, and 21 in. to 22 in. wide where the tug stops come about 15 in. from points. Breeching staples are 2 ft. from splinter bar, which is 1¾ in. wide by 1¾ in. deep, and let on tops of shafts ¾ in., clearing the front of the trap by an inch or so. The dash is 21 in. long and 12 in. high; axle, 1¼ in. at least with a 5-in. crank, and 3 ft. 7 in. between shoulders, clearing bottom of tub 9 in. The step is 10½ in. long, 6 in. wide, and 5 in. broad. The door handle is of 3½-in. plain brass. The door is 17 in. wide at the top and 15 in. at the bottom.



Trap for 13-Hands Pony.

The Manufacture of Nitrite of Soda.—The value of nitrite of soda in the improved methods of dyeing fabrics is increasing. Below is given a brief but authentic account of the manufacture of that chemical. The raw material, from which nitrite of soda is manufactured, is purified Chile saltpetre; the sodic chloride present in the latter lowers the value of the nitrite, but the elimination of the sodic chloride is an expensive operation not generally practised. The saltpetre is melted in large cast-iron vessels, and this involves the evaporation of the water and the decomposition of a part of the iodides and iodates which are in the saltpetre. The lead necessary for the decomposition of the saltpetre must be pure, as the presence of small quantities of other metals, especially of antimony, might cause the decrepitation of the whole charge. When the saltpetre, which melts at 310° C., has reached a temperature of 420° C., 14 parts of sheet lead are gradually added for every 5 parts of saltpetre, the whole being constantly stirred to obtain an intimate mixture. If the charge is too strongly heated the vessel might be pierced; if there appears a likelihood of the latter happening, add a quantity of cold saltpetre or withdraw the fire. Continue stirring after the lead has been added, and then, by means of a large cast-iron ladle, run the melted mass into cold water and assist the solution by constant stirring. The decomposition of the saltpetre by the lead at from 420° C. to 500° C. produces, besides the nitrite, about 1 per cent. of caustic soda, which dissolves some of the oxide of lead formed; to remove the latter, neutralise the solution with nitric acid. In this manner saltpetre is re-formed, the oxide of lead being precipitated as insoluble hydroxide. The neutralising may be effected either with nitrate of lead or with dilute sulphuric acid instead of nitric acid; of the two former, sulphuric acid is the cheaper, but by its use sulphate of soda is deposited in the concentrating vessels in the form of anhydrous salt. There are now in aqueous solution (1) nitrite, (2) undecomposed saltpetre, (3) caustic soda holding oxide of lead in solution, and (4) the soluble impurities of the saltpetre, such as chloride of sodium, etc. The insoluble residue which was precipitated consists of (1) oxide of lead, (2) a very small quantity of metallic lead which has escaped oxidation, and (3) peroxide of lead. The solution, diluted to from 6° B. to 8° B., is neutralised again with the same agent as was used before; the oxide of lead in solution is precipitated, and the neutralising agent is added as long as a precipitate will form. It may here be mentioned that it is commonly supposed, and most authors state, that nitrite of sodium has an alkaline reaction, but this is not the case, the pure nitrite being absolutely neutral. The neutralised solution is separated from the insoluble precipitate by any convenient method, and is then concentrated in cast-iron pans until it has a density of from 42° B. to 45° B. when warm. The insoluble precipitated residue is thrown upon a large filter of coarse sacking, where it is washed with warm water and the wash waters are added to the principal solution. The concentrated solutions are mixed together in cast-iron vats and left to crystallise; if the crystals thus obtained are not pure, they must be re-dissolved and re-crystallised. The pure crystals are separated in a centrifugal machine, washed, and dried. The desiccation takes place in an oven at a temperature of about 50° C., and the crystals are packed in parchment-paper cylinders of double thickness. The residuary oxide of lead may be melted and cast as it is, reduced to the metallic state, or transformed into minium, a heavy, brilliant red pigment which is used as a cement and paint, and in the manufacture of flint glass. The lead oxide can also be used in the preparation of white lead, of lead nitrate, lead acetate, and other plumbic compounds.

How to Produce Red Letters on Glass.—Red letters are produced on glass by a sand-blast process. The glass used for this purpose is known as ruby flashed glass. The letters that are to be produced are first cut out in paper. These paper letters are coated with a resist or protective covering composed of 1 part of ordinary hot glue and 1 part of glycerine, mixed together. The letters are then pasted on the glass, the resist side outwards, and the glass is then ready for blasting. The sand cuts away the unprotected surface of the glass, the resist protects the paper letters, and, when these are washed off the glass, red transparent letters will be shown on a white opaque ground.

Preparing Tannic Acid.—An impure tannic acid may be obtained from myrobalans (a dried astringent fruit resembling a prune) by grinding them and extracting in a boiler containing hot water; the liquid may be strained and evaporated to dryness, yielding a dry extract which is suitable for dyeing or tanning purposes. A concentrated fluid extract is often made by partial evaporation. To obtain a pure tannic acid, it would be necessary to treat the myrobalans in the same way as nutgalls, i.e. extract by percolating a mixture of alcohol and ether through the powder. The percolate will separate into two layers; the lower one is a watery layer containing the tannin, the upper layer contains the alcohol and ether, with colouring matter, etc. The alcohol and ether can be recovered largely by distillation; the watery layer is evaporated to dryness, and yields the pure acid.

Removing Stains from Linen.—Tea and fruit stains are removed from linen by steeping the latter in a chloride of lime solution (about ½lb. to 1 gal. of water), or preferably in hypochlorite of soda, which may be made by treating ½lb. of chloride of lime with ½ gal. of water, dissolving ½lb. of washing soda in ½ gal. of water, and mixing the two solutions. The solution should be allowed to remain till clear, the liquid, which is poured off from the deposit, being used for bleaching.

Making French Cork Boot.—In fitting the second insole of a French cork boot where a box and rand are sewn in, last the boot in the ordinary way, taking care that the feather is nice and even, and that there is a good innersole to work upon. For the box, a piece of first cut is cut the required length, say from 12 in. to 14 in., and about ½ in. wide. Mark a line, as A B (Fig. 1), on the grain side of the leather, ¼ in. from the edge, and cut it through a little way, then serve the reverse side in a similar manner, as at C. The leather should be damped, and the cuts made larger with a channel opener, a welt plough or knife being used to cut a thin strip of grain from the narrow side as at D. Or the box can be worked with one bevel edge (see E, Fig. 2). Instead of sewing in a welt, the box can be sewn in, and in doing this the awl will go in at A (Fig. 1) and come out at C. The piece taken out at D will admit of the box lying close to the upper, while the channel at C allows the stitch to sink in. If a box like Fig. 2 is used, the awl should go in at the dotted line on the bevel edge E and come out at F. This is also shown by the dotted lines G and H in Fig. 3, which is a transverse section of nearly the whole of the middle portion of the boot. Thus the awl goes in the innersole at J just as for a welt. When the box is sewn in all round, it can be gently hammered down, trimmed, and ironed up, as shown by the dotted line K. The welt, as shown at L (Fig. 3), is sewn in as follows:—Starting at the heel, sew up the waist to where it meets the box. Between these stitches put the awl under each loop, letting it grip the innersole and come out on the top of the box, thus sewing in the welt, and on to this the sole will be stitched as at M, N. A very thin layer of felt is put in, and the remainder filled up with sheet cork, excepting another thin layer of felt to keep the boot from creaking when the outer sole is put on.

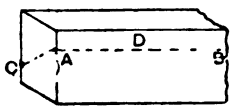


FIG. 1

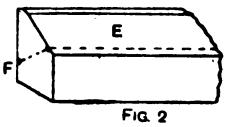


FIG. 2

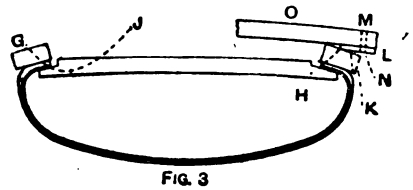


FIG. 3

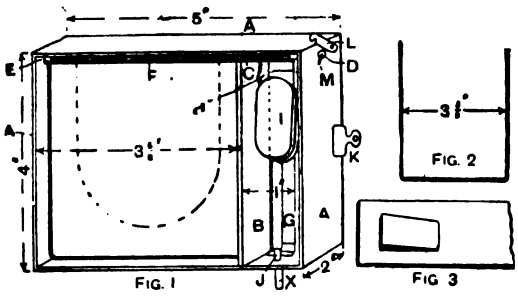
Making French Cork Boot.

Varnishing a Carriage in the Wood.—It is assumed that the vehicle to be varnished is made of four differently coloured woods—ash, creamy white; mahogany, reddish brown; hickory, flesh-coloured drab; and lancewood, straw colour. The straw colour of lancewood contrasts best with mahogany, so the two other light-coloured woods have to be tinted to match straw colour. For this purpose coat with a solution of gamboge and turpentine, a few drops of linseed oil being added to every pint of the stain; test on any odd bits of ash and hickory to make sure the stain is of the right tint. Prepared yellow stains might be diluted to answer the purpose. The staining does away with the patchwork look of the several light-coloured woods. The next process is to fill the wood grain. The dense lancewood will not need so much filling as the other woods. The filling is a nearly colourless liquid made by mixing together 2 parts of turpentine and 1 part of palest linseed oil; apply it with a stumpy-haired brush, and wipe off any superfluity with a clean white rag, rubbing the latter well into the wood to smooth the grain which the liquid filling has raised. After a day or so, brush in another filling. Make this with 2 parts of linseed oil and 1 part of turpentine, and add a tablespoonful of sugar of lead or of sulphate of copper driers to every pint of filling; the lead does not affect the colour of the filling so much as the sulphate of copper. Wipe with rag as before, and allow to stand for a day or two. If the weather makes the oil sweat out on the surface, wipe it thoroughly dry and then well brush on a light coat of pale copal varnish, following in a day or two with a finishing coat of hard-drying copal varnish. The surface of the first coat of varnish may be rubbed over with a bunch of clean horsehair to remove nibs and to grain it slightly; this dulness favours absorption of the next coat of varnish, which is a full flowing coat lightly laid on. Among the points it is necessary to remember are these. Do not let the varnish flow into recesses; let there be at all parts only the amount of varnish laid on with the brush; and always hold a small dry tool in the left hand with which to wipe off superfluous varnish. The ironwork, if quite bright, may be varnished with carriage copal varnish in which a little white lead, thinned with turpentine, has been mixed (a tablespoonful to 1 pt. of varnish). The ironwork must be free from grease or oil before it is varnished, or it will dry unevenly. Black japan is used for common work such as Ralli cars, but it does not harmonise with other colours. Leather, if used for dash-iron or wings, should be red-tan enamelled, or japan surface leather should be used; either of the leathers mentioned is more suitable than black leather for the purpose.

Gypsum, or Plaster-of-Paris.—Plaster-of-Paris, or gypsum, is a sulphate of lime found at places in Cheshire, Cumberland, Derbyshire, and Oxfordshire, in England, and at many places in the neighbourhood of Paris, France, hence one of the names given to it. It is also found in Germany, Switzerland, Italy, Spain, and North America. According to Burnell, it occurs "either in contemporary strata of great thickness (as near Paris) in the tertiary formations; or in the iridescent marls of La Meuse, or the Aveyron; or in masses of a subsequent date in different secondary rocks." The latter kind, being generally in contact with igneous rocks, is associated frequently with the dolomites, rocksalt, bitumen, and sulphur. The better qualities of gypsum have almost the hardness of calcareous stones, but after the evaporation of the water of crystallisation by burning they are easily powdered. On being moistened with water gypsum reassumes the hydrate form it possessed before it was burnt, and it crystallises on and around the substances between which it is placed, recovering its original density and strength. It is for this reason that gypsum is so extensively used in building. Gypsum is quarried underground and in the open either by cutting with picks and wedges or by blasting with explosives. The gypsum stone is broken up fairly fine and conveyed to the kilns, which are primitive structures, consisting of three brick walls supporting a tiled roof in which are openings to allow the escape of steam; one side of the kiln, which really is but a shed, is open. The gypsum is piled up in the form of arches, the larger stones being at the bottom, near the fireplace formed by the vaults of the arches. In the latter a wood fire is lighted, the flames rising through the crevices left between the stones. A greater heat than 200° C. over-calcines the gypsum, which then loses its power of combining with the water and reassuming its hydrous sulphate form. A better kiln than the shed form is that with its chimney passing round and round the gypsum, which thus does not come in contact with the smoke or fuel; the latter in the ruder form of kiln discolours the calcined article. Perhaps a still better method is the one in which advantage is taken of the fact that steam at very high temperatures is a gas possessing great affinity for water. The finely broken gypsum is subjected to the action of steam of the temperature of 205° C., and a pure anhydrous sulphate of lime is produced. The calcined gypsum is powdered in a mill, and is then ready for use. It is necessary to pack it very carefully, as in contact with a damp atmosphere it will rapidly spoil.

Recipes for Pottery Glaze.—Different clays have different shrinkage, require different firing, or stand a greater or less degree of temperature, hence the glaze is a matter of trial. Glazes are coloured by admixture of small quantities of metallic oxides. Common clay vessels are painted over with red-lead, but this glaze is dangerous, as it is affected by acids. Borax will make a glaze, and is used as a flux. A white earthenware glaze may be made from Cornish stone 35 parts, borax 20, crystals of soda 10, red-lead 20, and blue calx ½ part. Calcine and pulverise and grind with 20 lb. of white-lead, 10 lb. of Cornish stone, and 5 lb. of flint.

How to Make a Silent Camera Shutter.—A noiseless shutter that works inside the camera and that will give any length of exposure is made as described below. Being perfectly noiseless, they are particularly suitable when photographing children and animals. Exposures as brief as a quarter of a second may be given, which is generally sufficiently quick for such work. Construct a box A (Fig. 1) of the dimensions shown, dividing it 1 in. from the end with a strip of the same width B, having a slot C. Through this slot and also the holes D and E previously made in the framework a roller F, about ½ in. in diameter, is passed (a wooden knitting-needle answers well). In this roller burn two holes 3¼ in. apart, and into them fix the wire frame shown in Fig. 2 so that it hangs flat. Now cover rod and frame with thin velvet, gluing to the rod and sewing over the frame. Make a frame ½ in. wide and 1½ in. deep to fit the left-hand compartment, as shown by dotted lines. This frame is afterwards covered on its inner edge with velvet, making a light-tight join. Around the roller F glue one end of a strip of tape, 2 in. long, and wind the remainder around free, joining the loose end to a strip of wood G, about 3 in. long. G is hinged to the bottom with a small piece of tape also. Next wind some



How to Make a Silent Camera Shutter.

fine wire around a small rod to form the spring H, and fasten to this roller and the side of the framework as shown. If now the strip G is forced down, the roller is pulled round and the flap opens, but is pulled back by the spring directly G is released. For this purpose an india-rubber bellows I on a tube is fitted at J. It only remains to fit a strip across the right-hand compartment with, perhaps, a wedge-shaped block (as in Fig. 3) to give extra pressure to the bellows. A couple of bent plates K, one at each side, are for attaching to the camera front. The tube J projects for the pneumatic release at X. This should be fitted with a tap to keep the shutter open while focussing. The catch L and the pin M are used for the same purpose, or when long exposures are necessary and a cap must be used.

Varnishing Violin.—In preparing a violin for varnishing, commence by sandpapering it all over with No. 1 paper and freeing it from scratches. Go over the entire surface lightly with a clean, slightly damp sponge, and when the wood is dry it will be quite rough again; rub with No. 0 paper till smooth, and repeat the damping and papering until a dead smooth surface is obtained, quite free from scratches. It is not usual to stain violins, as a much finer effect is got by incorporating the colour with the varnish. The following process will give excellent results. Dilute 4 parts of good copal varnish with 1 part (by measure) of turpentine, and heat it quite hot, being careful not to let it catch fire. Go over the entire violin with this with a stiff brush, and rub in as much as it will take at one coat; this will not be much if the wood was well finished. When it is quite filled, make a pad of cotton-wool, done up in a fine cotton or linen rag, moisten this with turpentine, and clean the surfaces of the violin as rapidly as possible; then put on a coat of spirit varnish, made thus: Colour ½ pt. of methylated spirit with turmeric and red sanders wood. In another ½ pt. of methylated spirit dissolve 2 oz. of gum sandarach (juniper gum). Mix the two together, add two tablespoonfuls of Venice turpentine and 2 oz. of white shellac, and when dissolved, filter through cotton-wool or fine muslin. This elastic spirit varnish gives the violin the warm amber colour so much sought for. Lay on the varnish carefully with a large, round, camel-hair brush, avoiding streaks, and not going twice over the same place. It will dry very quickly, and three or four coats may be put on daily till the desired colour is reached; rub down with finely sifted pumice-powder and water and a woollen rag after every third coat. When a good body of varnish is on, the surface must be rubbed down with the pumice-powder till it is dull and smooth all over; the pumice is then thoroughly washed of. The final polish is obtained with tripoli and water, or crocus and linseed oil, on a rag, as before. After this is cleaned off, a brisk rub with the heel of the hand will give a surface like glass. The above instructions are applicable also to re-varnishing an old violin; but then it is necessary, in the preliminary sandpapering process, entirely to remove all traces of the old varnish. When that has been done, the work is identical with the above.

Coloured Printing Inks.—Printing ink is not usually made satisfactorily in the absence of big plant, but below are given some simple instructions easily followed. Into a 5-gal. iron pot pour 6 qt. of old linseed oil, and heat gradually over a fire to boiling point. As soon as the vapours that arise from the surface will catch fire when a light is applied, remove the pot from the fire and allow the oil to burn for a time; smother the flame by placing the lid over the pot. If the oil has thickened sufficiently, it will draw out into threads ½ in. long when dropped on a cold surface. If the oil is not thick enough, relight it, and allow it to burn down. If the oil is all right, stir till the frothing ceases, and put in gradually 6 lb. of crumbled amber resin, and keep stirring till all is melted. Then stir in 1½ lb. of sliced curd-soap, and when the frothing has ceased, place it on the fire, and bring to boiling point, stirring well all the time. This is printers' varnish. Varnish is best made out of doors; it smells unpleasant in boiling, and there is less risk of fire out of doors. To make brown ink, add varnish to a powdered mixture of 2 oz. of burnt umber and 1 oz. of rose pink, and grind till smooth with a muller. Indian red and Venetian red, toned with a very little lampblack, also give browns. A fine black ink may be made with 9 oz. of balsam of copaiba, 3 oz. of lampblack, 1½ oz. of indigo or Prussian blue, or ¼ oz. of each, ½ oz. of Indian red, and 3 oz. of dry turpentine soap. These are to be ground with the varnish till quite smooth with pestle and mortar or a muller and slab. For black varnish ink, 5 oz. of Prussian blue or indigo, or 2½ oz. of each, 4 lb. of mineral lampblack, and 3½ lb. of good lampblack, are mixed with warm varnish, and the whole is well ground on a slab with a muller.

Primary and Principal Colours.—There are three primary colours—red, yellow, and blue; the ten principal colours are Chinese white or baryta white, yellow ochre, Naples yellow, vermilion, Indian red, madder carmine, emerald green, ultramarine, Prussian blue, and ivory black or Indian ink.

Electro-brassing Solution.—For a solution for electro-brassing small iron goods, dissolve 1 lb. of good yellow sheet brass in sufficient warm dilute nitric acid to dissolve the brass without leaving any free acid; then add the whole to 8 gal. of rainwater. Now add liquor ammonia until the brass solution assumes a deep blue tint, then add a solution of cyanide of potassium until all the blue tint disappears. Filter through calico and add an equal bulk of rainwater to form the brassing bath. This must be worked with an anode of good yellow sheet brass, which should dissolve freely to maintain the solution in good working order. To obtain a uniform bright yellow deposit of brass on small iron goods held in baskets, some skill will be required, as the character of the deposit is influenced by the temperature of the solution, the density of the current, the proportions of metals, the size of the anodes, and the movement of the articles being plated. Very thick deposits of brass might be dipped in acid to improve their colour; it is not safe to dip thin ones.

Glazing Terra-cotta Tiles.—A glaze for terra-cotta tiles requiring only a moderate heat can be made from a solution of sugar of lead in hot water. Cover the tiles with the solution and expose to a clear red heat. A coke fire would probably be suitable, provided it does not touch the tiles in any way. A sagger, or receptacle, to hold the tiles may be made from a drain pipe. Limewash the inside of the pipe and set the tiles with the glazed surfaces facing each other. Try immersing them in salt or borax, and then bake or paint over with red-lead; this will give a deep red glaze.

Repairing Marble Clock Case.—To repair a broken corner of a marble clock case to imitate grain, which is light green, white, and black, a hard-setting cement can be used which is made by mixing plaster-of-Paris with white of egg. This can be used for re-forming the broken corners, and afterwards painted black and gently rubbed with furniture polish.

Gum Bichromate Process of Photography.—The gum bichromate process of photography is an old process, and is only suitable for large work, and for subjects that do not need much definition. The process itself is as follows. Cut some sheets of good cartridge paper into pieces rather larger than the negative to be printed from. Prepare a 10 per cent. solution of potassium bichromate and in it immerse the cut paper for from two to three minutes, taking care that the paper is evenly wetted. The immersion may be done in ordinary daylight, as the paper does not become sensitive until it is dry. In a room free from dust pin up the paper by the corners to dry. As soon as the paper is dry it must be kept in the dark, or as carefully guarded from actinic light as silver paper would be. Make up a 40 per cent. solution of gum arabic and filter and mix with it the pigment that is to be used, which would be either ordinary powder colours as obtained from the oilshop, or the water colours sold by artists' colourmen. The latter colours are preferable, as they are usually in a finer state of division. A thin coating of the mixture is then evenly applied to the paper, smoothing out with a large badger brush; dry thoroughly. The exposure may be timed by an actinometer, but is practically a trifle longer than would be required to make a print in albumen from a negative of similar density. Lay the print face downwards in cold water for half an hour and note the result. If correctly exposed there will probably be by this time a dim outline of the principal objects. Raise the temperature of the water and bathe very gently until the image is well out. Soak for a few minutes in alum and rinse well to remove the bichromate; this is all the fixing required. The paper should not be kept long after sensitising. Some examples of the gum process have been obtained by working up the softened gum with a brush. Carbon tissue allows of similar modifications.

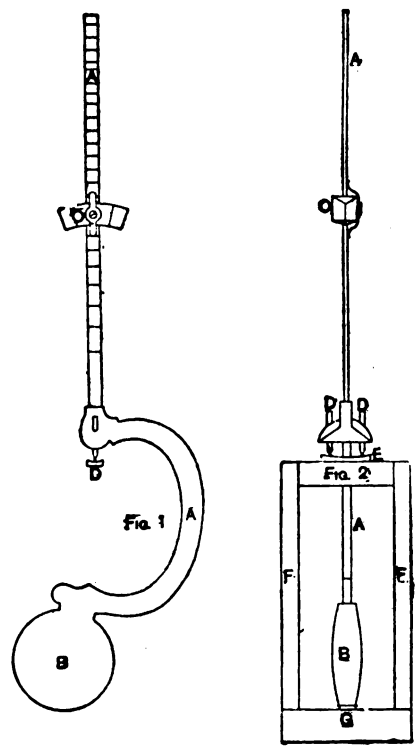
Determining Contents of Rectangular Tank.—To determine how many gallons of water would be held by a tank of specified dimensions, first find the contents in cubic feet, and then multiply by 6·23. The contents of a rectangular tank 6 ft. by 9 ft. by 4 ft. 6 in., equals $6 \times 9 \times 4\frac{1}{2} = 243$ cub. ft., so that the water contained should measure $243 \times 6{\cdot}23 = 1{,}514$ gal. (approximately).

Making a Theatrical Bald Wig.—In making a bald wig such as is worn on the theatrical stage, a piece of stout calico should be tightly stretched over a suitable dummy, which is generally a wooden block, and the calico should be tied or tacked round the neck of the dummy. Give the calico a coat of hot jelly size, which should be followed by two coats of flake white. The medium for applying the colour should consist of copal varnish, linseed oil, turps, and a few drops of gold size. Each coat must be dry and hard before the next is applied. The flesh tints may be obtained by mixing small quantities of rose madder and Indian yellow with flake white, the medium being the same as before.

Simple Metronomes.—A metronome, a device for measuring and beating time in music, may be made with a piece of tape and a weight, or it may be an elaborate clockwork arrangement. For the tape and weight metronome, the distances from the centre of the weight to the point of suspension should be as follow:—

No. of Beats per Minute.	*Distance in Inches*
60	39·14
70	28·75
80	22·01
84	19·87
86	19·01
90	17·39
100	14·09
105	12·88
110	11·64
120	9·78
126	8·87
130	8·34

Slightly more advanced than the weighted tape in suspension is the metronome illustrated by Figs. 1 and 2. It is, however, of simple construction though it will answer quite as well as a more elaborate arrangement. Of the compound pendulum, A is the rod, B the bob, and C a small supplementary weight which slides up and down the upper part of the rod. With C at the top end the pendulum, on being set in motion, will swing for twenty minutes or more at the rate of about forty-eight beats to the minute; when C is at the bottom end, near the pivots, the pendulum will swing for a shorter time at the rate of about 144 to the minute. These matters having been determined by experiment, the intermediate speeds are measured off on the rod; the divisions are closer together as they approach the top, as shown at Fig. 1. The pendulum should be cast in brass, and only the top part of the rod, on which the weight is to slide, need be filed to $\frac{5}{16}$ in. in breadth and $\frac{1}{8}$ in. in thickness. The pivots are shown at D (Figs. 1 and 2); they are two pins of tempered steel filed to a sharp point and driven tightly into holes drilled through the projections on the sides of the rod as shown in Fig. 2. The points work on a smooth piece of brass E (Fig. 2) which is slightly hollowed out on its top side in both directions for the purpose of enabling the pendulum to swing itself perpendicular when set up on an uneven surface. A small steel spring is screwed on one side of the weight C to keep the latter at any desired height, though it allows the weight to be slid easily up and down the rod when required. The bob



A Simple Metronome.

B is placed slightly off the centre (to the left) to compensate for the weight of the bend on the right. The stand has a mahogany base G (Fig. 2) 3 in. by 2 in. by ½ in., with two uprights F 5½ in. by ¾ in. by ¼ in., and a cross-bar to support the brass plate E.

Cutting Tiles.—A white glazed tile may be cut into two pieces by laying it flat on a soft wood board and cutting very carefully with a chisel. To reduce the size of a tile, or to take an irregular-shaped piece out of it, break or pinch off pieces with a pair of pincers of about 7-in. size. The edges can be rubbed down on a stone if required to be very neat.

Cleaning Furs.—These are methods of cleaning furs. (*a*) Rub with *hot* roasted bran, allowing the bran to enter the fur well. Then shake the fur and well brush. (*b*) Moisten bran with hot water and well rub it into the fur with a piece of clean flannel. Now take some dry bran and a clean dry flannel and rub this well in until the wet bran and the fur have become dry. To remove the bran, give the fur a good shake, a sharp but light beating with a cane, and brush with a soft brush. (*c*) Mix and heat in an oven equal parts of flour and fine salt, and thoroughly rub the hot mixture into the roots of the fur. Now well shake the fur, then throw it over the back of a chair, fur side upwards, and brush out any of the mixture left, using the end of a soft brush, and giving sharp "dabs" so as to get to the bottom of the channel formed by the parting of the fur, blowing well all the time.

The Manufacture of Water Colours.—Cake and moist water colours are made by grinding the dry pigments in a mill with gum water and a little glycerine or honey to prevent them becoming too brittle; the pasty material is rolled out and cut into squares, partly dried, and then pressed in moulds or placed in tins. For the moist colours more gum water is used than for the cakes. The gum water is made by dissolving purest gum arabic in twice its weight of water and straining through muslin, then adding a little glycerine and a few drops of oil of cloves. Very little glycerine must be used or the colours will tend to absorb moisture from the air and fade or become bad.

Making Leather Case for Croquet Mallet.—The leather for a croquet mallet case need not be very stout, but it must not be flimsy, unless it is backed with something, or it will wring in the sewing, and the handle portion will be unsightly. The leather used for the straps of bags, etc., will be suitable. Before cutting the leather, cut from stout cartridge paper a pattern to the shape of the mallet. Fig. 1 is the cover for the handle, which is 3 ft. long and 5 in. wide; Fig. 2 shows the cover for the mallet, which is 12½ in. long by 13 in. wide; while Fig. 3 is a

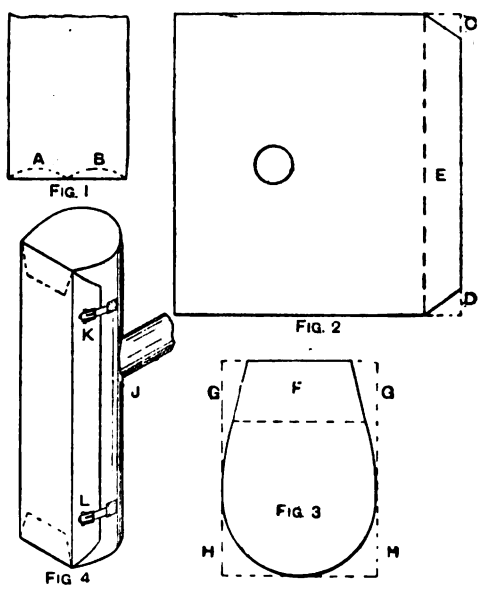


FIG. 1. FIG. 2. FIG. 3. FIG 4.

Making Leather Case for Croquet Mallet.

pattern for the two ends, which is 3½ in. wide by 4½ in. deep. Two small arcs are cut out of Fig. 1, as A, B, so as to fit a hole 1¼ in. diameter cut in Fig. 2 after it is curved to the outline of Fig. 3. In Fig. 2, 1¼ in. is marked off at one side and the two corners are cut off, as C and D. The circular hole is then cut out, the centre being about 4½ in. from the left-hand side, so as to be in the centre of the case when finished. In Fig. 3, 1 in. is allowed on top for a lap. The pieces E and F (Figs. 2 and 3) will form themselves into flaps if a piece is grooved out along the dotted line. To get the piece, Fig. 3, a good shape, cut an oblong piece to the measurements given above and fold it down the centre, and then cut off the corners G and H. Fig. 1 is now sewn into cylindrical form so as to take the handle, the circular piece, 1¼ in. diameter, as cut out of Fig. 2, being sewn to one end, the other end, with curves A and B (Fig. 1), being fitted into the socket hole at J (Fig. 4), and the straps and buckles sewn on at K and L. To give a good appearance to the case when finished, a little plush may be fixed in with glue paste; if desired, a cheaper lining can be used.

Notes on Re-painting a House.—In commencing to re-paint a house, begin in the upper rooms, first washing off the ceilings, then stripping off the paper from the walls by applying water just where it is wanted, allowing sufficient time for it to soak, and removing a piece at a time. If a little soda or lime has been put in the water so as to more easily remove the paper, wash the work with dilute caustic soda. Contagious matter and certain insects are frequently retained in the paper, and the caustic soda acts as a disinfectant. Repair the bad places with plaster and whiting; and it is sometimes desirable to coat with size to stop suction, and to put on lining-paper to make a sound job and hold the plaster together. The next job is to clearcole the ceiling. Put some whiting in a pail, cover with water till the lime in the whiting is slaked, pour off the water, and thoroughly mix in some hot size and add colour at the same time, if the ceiling is to be coloured, or a little black if the ceiling is to be quite white. The black removes the yellow tone or raw appearance of the white. Strain the colour through canvas before using. The first coat for the ceiling is used thin and hot; the second is used with the chilled colour, so that it will go on thick. Do not lay the colour off, as in oil-painting, but put it on with short strokes, in varying directions, so that the light from the windows will not catch the lines likely to be made by strokes of the brush. The distemper has to be put on full, as contrasted with oil-colour, which has to be spread. When the ceiling and walls have been repaired, and the ceiling coloured, the paintwork is washed and rubbed with pumice-stone and soda-water, bad places being afterwards filled up with putty. Sometimes panels have to be filled up with distemper, and rubbed down with a flat cork covered with glasspaper. This latter is hard work if there was too much size in the distemper. When the filling-up has been brought to a surface, it should have a coat of paint, which should be nearly all oil. Door frames, window frames and sashes, and all wood mouldings, should have their corners scraped and brushed out. The mantelpieces should be well washed with strong soda- and lime-water, which should be kept on for a time so that it may penetrate. The mantelpieces can then be washed off with clean water and allowed to dry. Having got the woodwork to a fairly level face, coat it with colour. Colour the door frames first, and then the edges and panels of the door. After laying off the latter, commence the rest of the door at the middle upright stiles, afterwards doing the cross stiles. Finish by squaring off the two outside stiles, always remembering that the object is so to put on colour that an even smooth surface is obtained quickly. Be careful of the glasspaper, and bear in mind that its purpose is to make smooth, not to take off paint. Also remember that a brush mark in the first coat will show in the last one. Commence priming and painting at the right-hand corner of the house, doors, rooms, and windows, working to the left all through the house. If convenient, leave the staircase to the last, previous to preparing the skirting, for which sienna is the best pigment, as it does not show the damage as much as other colours. The staircase stringing may be painted plain, coloured, or it may be grained and varnished. If the outside doors are much cracked or blistered, the old paint must be removed. This may be done by brushing on a solution of 2 lb. of washing soda in 3 gal. of water, thickened with lime dissolved in hot water. When softened, the paint is scraped off, or, instead, the paint may be burnt off with a flame. The flame is the better method, as the soda-water may leave moisture, which is the cause of blisters. In painting street doors, precautions should be taken against subsequent blistering. On this account, it is wiser not to use water or any stripping material whatever on the door, but to burn off the paint with flame. Keep the brushes in oil overnight—not in water. Of course oil, as far as possible, should be kept out of the colour, as that, as well as water, will cause blistering under the action of the sun. In preparing the front of a house for repainting, begin at the right-hand side, and clean out the spouting, windows, etc.; continue in the same way to the bottom, rubbing downwards. Commence painting at the spouting, window sashes, and panes. Then work down the front with a coat of priming, taking doors and shutters in due course. For a black and dirty compo. front, it is best to stain the lead with black to a light grey, as the next coat will give it a solid appearance. In mixing colour for outdoor work, use principally or wholly boiled oil, unless it be for decorative parts of the house, when the ordinary method may be employed. The compo. front may be repaired in places if necessary with Parian cement, as this can be smoothed off and painted immediately.

Preparation of Selenium.—Selenium is a non-metallic element with properties somewhat like sulphur. Selenium in combination with oxygen forms several acids, but cannot be said to form salts like those of metals; it does, however, unite with chlorine in several proportions. The best known chlorides are selenium monochloride and selenium tetrachloride. These products are obtained by the action of chlorine gas upon selenium.

Removing Wool from Sheepskin.—Soak sheepskins in lime water until the wool can be removed by scraping with a two-handled blunt knife; or leave the skin in a dark, warm, and moist place until sufficient decomposition has taken place to enable the wool to be easily scraped off.

Mounting Photographic Prints.—This is the plan adopted by professional photographers for mounting prints. Immerse the trimmed prints in water for a few minutes and then place face downwards one on the other on a sheet of glass. Squeeze out the excess of water with a roller squeegee and blot off the surface. Brush over the back of the print with cold starch paste, free from lumps, taking care that the edges of the print are well covered. Raise the print by the corners, lay it in position on the mount, place over it a sheet of fluffless blotting paper, and roll into contact. Continued or heavy rolling is unnecessary. If too much starch is used it will be squeezed out around the edges of the print; if too little is used the print may not stick at all. Should any starch spread on to the mount it is sometimes advisable to remove it by sponging over the whole mount. In mounting, first estimate the position of two opposite corners, then lay the print down so that it touches the mount diagonally. Starch paste more than one day old should not be used, and all lumps, even very small ones, should be carefully removed. Platinotypes require more starching, and do not stick if the undried mounted prints are laid together.

Making Three-legged Folding Fishing Stool.—Below are instructions on making an angler's three-legged folding stool. Commence by marking out the section full size as shown by Fig. 1. Make a three-legged bolt out of $\frac{1}{8}$-in. iron, as shown at A (Fig. 1). Thread the ends, and fit them with circular brass nuts B $\frac{1}{8}$ in. thick, and square washers C and D. Each washer must be drilled in the centre and the four corners. A hole must be drilled to take a No. 4 screw. Three pieces of hickory,

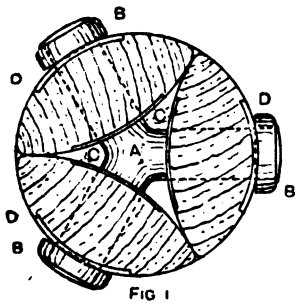


FIG 1

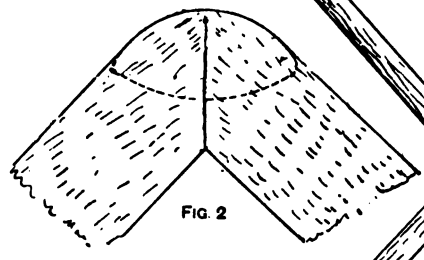


FIG. 2

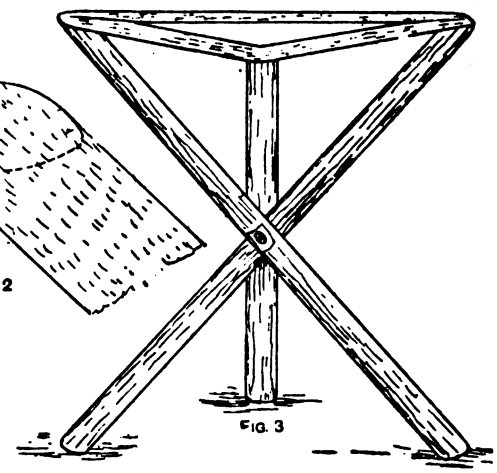


FIG. 3

Making Three-legged Folding Fishing Stool.

ash, or lancewood about 18 in. long, and properly shaped, can be used for the legs. Bore the centre of each leg with a $\frac{1}{8}$-in. bit, and fit the washers on. Put the legs on the centre bolt and screw up, leaving sufficient clearance for the stool to open properly. The ends of the bolts should then be cut off, but enough should be left beyond the nuts for riveting. Open the stool to the required width and cut off the ends top and bottom to the correct bevel, then take to pieces and finish with sandpaper and French polish. Three pieces of strong webbing are sewn together at the corners (as shown at Fig. 2) to form a triangle the size of the stool when open. Put the stool together, rivet over the ends of the bolts, open as at Fig. 3, and tack the webbing on the corners at the top.

How to Make Dry Soap.—A good dry soap can be made without the aid of expensive plant. To 40 gal. of water contained in a steam-jacketed pan add from 2 to 2½ cwt. of soap cut up as fine as possible. A white curd soap with free lathering properties is best; on no account must a yellow soap be employed. This mixture is stirred until the soap has entirely dissolved and the mixture is pasty. Now add, in small quantities at a time, 4 cwt. of soda ash, stirring well all the time, then run the soap into shallow galvanised iron trays to cool. When cold, the mass will begin to break up into small pieces. It should be ground to powder in a mill—preferably an edge runner mill or disintegrator.

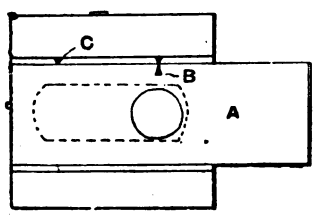
Foundations for Gas Engine.—A solid mass of Portland cement concrete makes a good foundation for a gas engine, and is easily constructed. Solid brickwork is also used, but the excavation required is more than with concrete on account of working room being required for the bricksetters. The best shape for the foundation is as nearly cubical as possible; if made long and narrow, and deeper than it is wide, there is a tendency to rock. To prevent vibration being conveyed to the walls of the building such foundations are sometimes isolated by forming an open trench all round; but if the site of the engine is near a wall it is better to lay a concrete floor under the footings of the wall and make it form part of the same mass as the engine foundation, so that the weight of the building helps to steady the foundation. A stone bedplate should be provided between the concrete and the engine bed. For securing the engine to the foundation, holding-down bolts with anchor plates at the bottom ends may be buried in the concrete, being first placed in their exact positions with the aid of a template marked off the bed of the engine. The upper ends of these bolts are screwed to receive the nuts which hold down the engine. Another method is to cast holes in the concrete through which the bolts may be passed downwards, in which case the heads of the bolts may be at the top and the nuts are tightened up through hand-holes constructed at the bottom ends, but this necessitates leaving a trench for access to the hand-holes. Cotters at the bottom ends of the bolts are easier to adjust than nuts.

Inserting New Wrest plank in Piano.—Wrest-planks of pianos should be built up of three sections—a beech centre, a maple or sycamore facing ¼ in. or ⅜ in. thick, and a pine backing. If the facing alone is split, it is only necessary to replace that portion; but if the plank is so split that a new one must be inserted, proceed as follows. First remove all the wires. If the covered ones can be used again, thread them on a piece of wire in the order in which they were taken off. Remove the wrest-pins, and with a stout piece of brown paper and heelball make a clean imprint of the holes, bridge, etc. Carefully remove the bridge screws or bolts; the old plank may then be chopped out with a mallet and stout chisel. The prepared plank should be cut to exact length and secured in position with good hot glue, and screwed up tightly for several days with iron cramps having deep jaws. When these are removed, clean up the face for the bridge and holes for wrest-pins, their exact positions being determined by means of the brown paper, which is laid in position, and secured while a sharp tap is given with a hammer and centre punch where the holes should be bored. The bridge should be fastened with hot thin glue and brass pins and the necessary bolts, screws, or dowels, and a piece of mahogany or birch capping laid on. But if the instrument is fitted with a half lid it should have a final cleaning up, and several coats of white hard spirit varnish should be applied before the wrest-pins are inserted.

Making Golf Balls.—Golf balls are made from pure guttapercha, procurable in rods and ready for cutting into pieces suitable for the mould, which should be of size 2¼. To prevent waste, the cutting is done with a knife operated on the guillotine system; the pieces should be slightly larger than will exactly fill the mould, the superfluous guttapercha being afterwards pared off with a very sharp knife. Before moulding, the guttapercha requires to be thoroughly softened in water kept hot over a fire. The guttapercha is then placed in the engraved mould, and subjected to great pressure. After the balls are made they should be put away in a dry, warm place for about three months to allow them to become thoroughly seasoned. They are then given three coverings of special paint, a small quantity being put on the palm of one hand, and the ball rolled between the palms of both hands. Two days should elapse between each covering, and in a week after the last covering the balls are ready for use.

Preparing Tartaric Acid.—Tartaric acid is largely made from wine lees, *i.e.* the deposit formed when wine is kept in casks. Tamarinds may be extracted with boiling water, the liquid being mixed with a little pipeclay and filtered through animal charcoal to decolourise it. Powdered chalk should be added to the liquid until it ceases to effervesce; the precipitate should be collected on a filter cloth, and a solution of calcium chloride added to the filtrate until it ceases to give a precipitate; the precipitate is tartrate of lime, and should be collected along with the first precipitate. The precipitate should be mixed with a little water and dilute sulphuric acid added in very slight excess. The liquid should then be filtered, evaporated gently to a syrup, and left to crystallise. The crystals may be washed two or three times with cold water, which may be added to the next lot of acid required, and the crystals of tartaric acid should be dissolved in the least possible quantity of hot water, and the solution evaporated and allowed to crystallise again to get rid of the sulphuric acid.

Stereoscopic Photography.—Stereoscopic effect or the appearance of relief depends upon the combining in one in the stereoscope of two representations of the same scene taken from slightly different points of view. Stereoscopic photographs, therefore, are best obtained with a camera having a pair of lenses fitted side by side. These lenses should be accurately matched as regards focus, ratio, aperture, colour, etc., and should be 2½ in. apart, which is about the distance between the eyes. With this camera two pictures will be taken at the same time. Paired lenses are sold for the purpose. A method of taking stereoscopic photographs with one lens only (a half-plate camera being used) is to employ a couple of mirrors set at such an angle as to have two points of sight. These mirrors are placed in front of the lens and reflect the image through the lens on to the plate. The instrument is known as a stereoscopic transmitter. Still objects, and ordinary landscapes in which there are no moving figures, can be taken with only one lens if the camera is fitted with a sliding front. Such a camera must have square bellows. The above sketch explains the construction of a sliding front. The first exposure is made, and A is then pushed along until the mark B points to the mark C. The opening in the front board of the camera is shown by dotted lines. The distance between the two points may be varied according to the distance of the principal object. The farther the principal object is from the camera the greater must be the separation between the two points. Sometimes it is possible to obtain stereoscopic photographs by moving the object, as, for example, a vase of flowers. In this case the camera and lens are stationary and an ordinary quarter-plate camera can be used. Such a camera may also be used if it is fitted with a board as wide as the base from back to front and about double the length of the original base. Two parallel slots are made in this extra baseboard, and thumbscrews pass through these into the original baseboard. The camera may thus be slid easily from one position to the other and clamped. A great deal depends upon correct mounting of the prints; this is a process that is described on another page, but suffice it to say that the picture that was on the left hand of the camera becomes the right-hand print when mounted.



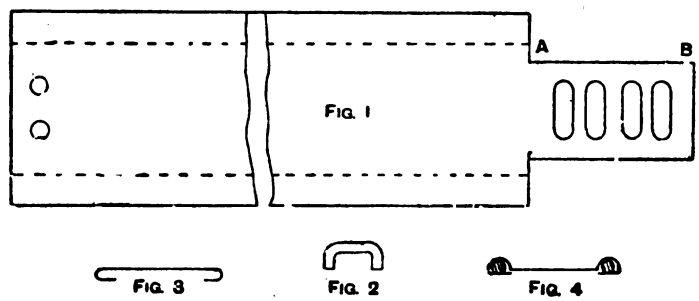
Sliding Front of Camera for Stereoscopic Photography.

Bunsen Burner for Acetylene Gas.—To make a Bunsen burner for acetylene the tube must be extremely narrow, and it is even then found to be very liable to flash back, while it requires a high pressure to bring about satisfactory combustion of the gas with an absolutely non-luminous flame. One of the chief difficulties to be overcome is due to the range over which mixtures of air and acetylene are explosive, and which lies between the limits of 3 per cent. and 82 per cent. of acetylene. The propagation of the explosive wave down the burner tube cannot be satisfactorily stopped by the ordinary device of using wire gauze, on account of the low igniting point of mixtures of acetylene and air; while if high pressures are used so that the rate of flow shall be greater than the propagation downwards, more air is sucked in by the uprush of the gas and the velocity of the explosion is again increased. The best results in acetylene Bunsens have been obtained by taking a Bunsen burner in which a constriction in the air-tube creates a high velocity at the particular point where the explosive wave starts to propagate downwards.

Cleaning White Kid Gloves and Shoes.—For cleaning white kid gloves, make a paste by boiling 1 part of white curd soap with 4 parts of water, and adding a small quantity of ammonia; place the glove on a wooden hand and rub well with the paste, laid on with a sponge, until the glove is thoroughly cleaned. Any worn parts may be improved by rubbing in a little magnesia or white French chalk. Rub the glove dry with a clean cloth, and, after removal from the hand, work the glove about to render it supple again, then press with a heavy weight. Kid boots can be cleaned with the same paste, followed by the French chalk.

Removing Grease Stains from Wall-paper.—To remove grease stains from wall-paper, make a thin paste by mixing powdered starch or flour with benzoline (petroleum spirit). In this mixture dip a sponge, and with it make a ring around the stain. While the ring is still wet, thoroughly soak the stained parts with the mixture. Allow the paste to dry, then remove the powder with a clean soft brush. The object of making the ring around the stain is to prevent the oil being carried away from the spots and forming a ring in the paper, as it does by the usual method of treatment.

Making Brass Dog Collar.—These are instructions on making a brass collar for a dog. Cut a strip of brass 1¼ in. wide, and equal in length to the circumference of the dog's neck, with an additional allowance for lap at the end, as shown at A B (Fig. 1). Punch two small holes at the opposite end, into which the ends of the wire staple (Fig. 2) will fit, and also punch out the slots at the end A B. Now fold over the long edges along the dotted line shown, until the section formed is as shown by Fig. 3. Then wire along each side in a crease iron; this would make the section as shown by Fig. 4. Turn the collar round and solder the staple firmly in position and flush on the inside. Any one of the slots on the end opposite the staple end would then hook over the staple, and the collar could be fastened with a small padlock.



Making Brass Dog Collar.

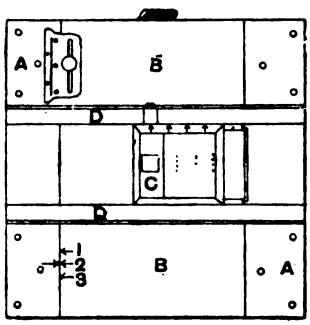
Use of Watch Depth Tool.—A depth tool is used more in making than in repairing watches. It is required for scoring off the exact position of the pivot holes upon the watch plates, previous to drilling them. It consists of two parallel frames, hinged together and capable of being adjusted by a thumbscrew to any required distance apart. Each frame is provided with runners like a small pair of turns. In one frame a wheel is placed, in the other a pinion. The frames are then adjusted to such a distance apart that the wheel runs nicely with the pinion. The outside points of the runners can then be used as a pair of compasses to transfer the exact distance to the watch plate.

Removing Varnish from Boots.—It is difficult to remove the varnish by means of a solvent from patent leather boots; it is better to tree these up tight and rub down with No. 1½ sandpaper, then with No. 1, and finally with flour sandpaper, and when the surface is smooth, to revarnish. The above process will also be suitable if the boots are of calf. But if it is desired afterwards to clean the boots with blacking, first soften the old varnish with a little spirits of wine on a piece of good cloth, and then apply a coat of dubbin.

Browning Bottoms of Boots.—To brown the bottoms of boots, put some thin brown paste on the bottoms and well sleek them just before they are quite dry; repeat till an even colour is obtained, and finish with white heel-ball and cloth. Or whiten the leather, and burnish with a warm burnisher; this will give a darker brown. Finish as above. Another method is to rub a little of the colour on a damp sponge, apply to the boot bottoms, and finish as above. Any brown colour will give the desired effect. To gain an easier finish, instead of using white heel-ball, make some white or brown fake, and, after burnishing, place a little on the boots with the finger, and when nearly dry, rub off with a cloth.

Bleaching Straw.—Brown straw may be bleached by boiling in a solution of washing soda, and, whilst still moist, submitting it to the action of sulphurous acid. To do this, the straw must be hung in a nearly closed chamber; a box or barrel will do if only a small quantity of straw is to be bleached. A piece of roll sulphur is placed on a saucer and set fire to by a hot iron rod; the saucer is then placed in the chamber (below the straw, but not too near it) and left burning for some time. After bleaching, the straw should be washed with warm water to remove excess of sulphurous acid.

Photographing Several Objects at Different Times on One Plate.—It is possible to take twelve different pictures of various subjects on one 5-in. by 4-in. plate, one lens only being used. A repeating back to the camera



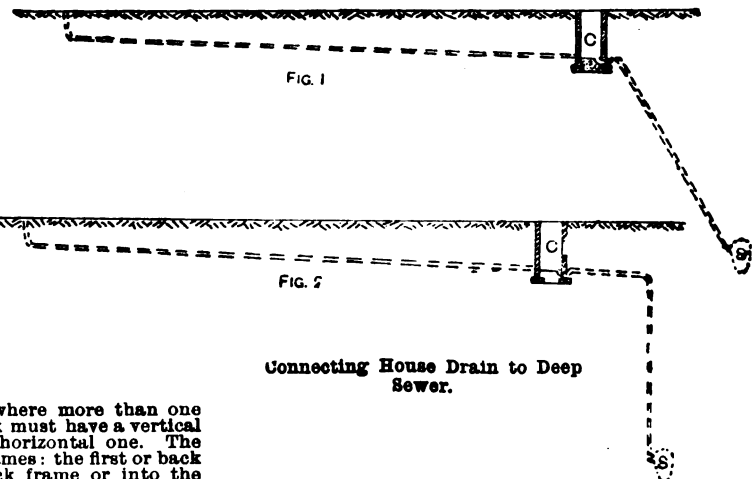
Double Repeating Back for Camera.

is needed for such work. But where more than one row of pictures is taken, the back must have a vertical sliding movement as well as a horizontal one. The reversing back is made in two frames: the first or back frame fastens to the camera back frame or into the reversing back catches; the second consists of two rails A A, between which runs a sliding board B with opening C of the desired size, say 1 in. square. Across from A to A run the slide rails D, with a catch in the top and three cuts in the slide to engage with the catch. For the first exposure the slide is put in as shown in the sketch, and is moved forward for each successive one. After three exposures have been made, the sliding board is then lowered to the next point and the slide pulled back to the first position again. By lowering the board and pulling back the slide twice more in this way, twelve exposures, each about 1 in. square, may be made on a 5-in. by 4-in. plate, as has been stated.

Particulars of Welsbach Burner.—Mention is made below of the principal points to be attended to in order to get good results with the Welsbach burner. The burners ordinarily supplied are intended for use with gas of from fifteen to twenty candle-power, and it is an advantage to know whether the gas comes within this range, since it is generally necessary to use slightly larger nipples for a poorer gas and smaller nipples for a richer gas. It is also necessary to know the average pressure during lighting hours, and to select the nipple most suitable for that particular pressure; if, for instance, the pressure varies from 1 in. to 2½ in. during lighting hours, select a nipple most suitable for 1½-in. pressure. Having decided on the most suitable nipple, take care that it is screwed into the socket gas-tight, as the least leakage will cause a bad Bunsen flame; the nipple itself should be examined to see that its interior is quite free from dust, grit, or other foreign substance, and on lighting the gas on the nipple (without the Bunsen tube) the flame ought to be perfectly vertical. See that the wheel on the top of the Bunsen is exactly centred, and lies evenly, perfectly flush with the top of the burner, otherwise the Bunsen flame will be one-sided and cause the mantle to shrink more on one side than the other; the result being that the mantle will be out of shape after burning a few hours. See that all burners are fitted perfectly upright and that the right-sized rod is used with every burner. The rods should be fitted into the burner pretty tightly; if they fit loosely they may be packed with a little asbestos. Also note that the Bunsen flame of the Kern burner is quite different from the ordinary "C" burner. The ring just above the wheel should be of a whitish-blue colour, not green. The mantle ought to be fully incandescent from top to bottom, and no flame should be visible outside or above the mantle. Should the Bunsen flame of the new burner resemble that of the "C" burner it would indicate that the nipple on the burner is too large, or that the flame when lighted on the nipple (without the Bunsen tube) is not vertical. This should be remedied, as it means a loss of forty per cent. of light.

Skeletonising Animals' Skulls.—The usual method of cleaning animals' skulls is to soak the bones in water frequently changed until the flesh becomes decomposed and able to be removed with the fingers and small pieces of wood. This takes some time and is disgusting work. As an experiment, try some wood ashes in the water. Begin by using, say, a handful of wood ashes to a gallon of water, and increase gradually.

Connecting House Drain to Deep Sewer.—In laying a 4-in. diameter house drain, which is 50 ft. long, to join



Connecting House Drain to Deep Sewer.

a sewer which is 20 ft. below the level of the house, the pipes should be laid at a reasonable depth, say, 2 ft. 6 in. or 3 ft., with a proper fall to the intercepting chamber. The drain should then either be taken down by a quick fall (as in Fig. 1), or by a vertical drop (as in Fig. 2). In the figures, S indicates the sewer, and C the intercepting chamber. Such a case as this is neither contemplated nor provided for in the Model Bye-laws.

Watch Going too Fast.—A watch will sometimes gain even when the regulator is pushed as far as possible towards "slow." The regulator of every watch is provided with two curb pins, between which the outer coil of the hairspring passes, and in the case mentioned it may be found that the hairspring does not vibrate freely between the curb pins, but binds against one of them. If it already vibrates, opening the curb pins to give more play will cause the watch to go slower.

Varnishing Violin.—Both oil and spirit varnishes are used on violins; the former give quicker results. Oil varnishes should be allowed an interval of at least two days between each coat; each kind of varnish should be dulled with pumice before applying another coat. Coating with boiled oil before varnishing is not advised. A yellow tinge may be imparted by the aid of gamboge and turpentine. A quantity of essential oil of turpentine being put in a cup, it should be placed in a water bath on a gas or oil stove and brought to a gentle heat and as much gamboge added as the oil will take up. Carefully strain, and apply with a camel-hair brush; a second coat may be given in three hours' time. The first coat of good spirit varnish may be applied the next day.

Making Polishing Buffs.—Buffs for polishing metal are made by fastening thick buff leather with best strong glue to the edges of wooden wheels, the ends of the leather being secured by nails until firm. The edges are then covered with glue and rolled in the emery powder (which should be placed in a flat tray), making sure that a good coating is on the leather. This process must be repeated as found necessary.

Curing Sheepskins.—Below is given information on curing and dyeing sheepskins. The skins should first be "fleshed," that is, freed by a sharp knife from any fat or flesh. They are then cured or tawed by placing in some preservative; a suitable one consists of 1 lb. of alum, ½ lb. of salt, about ½ peck of bran, and 1 gal. of boiling water. This should be well mixed and covered for some time to allow the bran to swell. The skins are left in the preservative for a day or two, or until the tawing is completed, which may be known by a white line being left when a part of the skin is folded and pinched. The skins are now taken out, stretched on a frame or door, and curried. This is done by scraping in every direction to remove the inner part of the skin. Or they may be curried and stretched after. They are now dried and the scraping continued, being supplemented by shaking and rubbing between the finger knuckles.

Setting Out Dovetailing.—In setting out dovetailing first set out the shoulder lines on each piece; if the ends are shot true this may be done by a gauge. Mark off the centre of each socket, and then half the breadth of

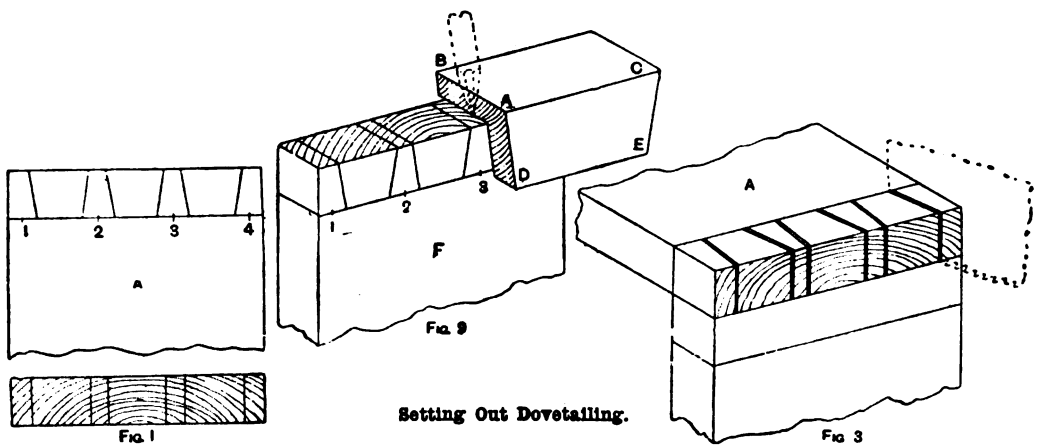


Fig. 1 Fig. 2 Fig. 3

Setting Out Dovetailing.

the sockets on each side as at A (Fig. 1). Make a template as shown at Fig. 2, the edge AB being square to AC; AD and CE should be about 80° to the edge AC. Then mark out the sockets with a template and a sharp pencil (or awl) as indicated at Fig. 2. Saw carefully in the waste parts; then place the socket piece on the pin piece, and mark the shape of the latter by using the end of a saw placed in the sockets (see Fig. 3). A, Fig. 1, F, Fig. 2, and A, Fig. 3, refer to the same side.

Cleaning Coral.—Coral that has become very dusty may be cleaned in this manner. In a large pan full of soapsuds hang the coral in a net so that it is submerged, but does not touch either the sides or bottom of the pan, and place the pan on the fire and boil. Then take it off, throw away the water, wash the coral in clean water, replace it in the net, and put it back in the pan as before; fill up with clean water and again bring to the boil. Remove coral, rinse in clean water, and allow to drain.

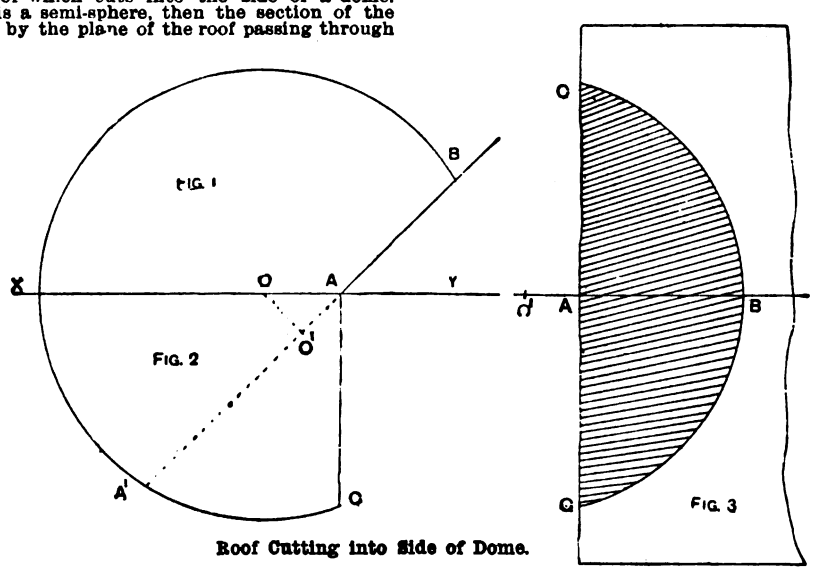
Dressing Tarpaulins.—Railway companies generally use a prepared sheet dressing for yellow tarpaulins. For a yellow dressing, use boiled linseed oil coloured with yellow ochre; if it does not dry quick enough, add a little patent driers. First give the canvas a good dressing with plain boiled oil; when that is dry, coat both sides with the coloured dressing. The dressing should take several days to dry; if it dries quickly it will be liable to crack.

Bronzing Metal Urns and Other Vessels.—Metal tea-urns, spirit measures, etc., are usually bronzed after all seams have been brazed and the metal has been worked to shape. One method of bronzing is as follows. First pickle the article in spirit of salts, then scour it quite clean and free from grease with sand. Procure some crocus of the desired shade, mix to a fine paste with water, and coat the surface to be bronzed thinly and equally. Build up a clear coke fire on the forge, over which move the article about until the paste is quite dry. Place some coal on the fire to render it smoky, and expose the article to the fumes till the surface is quite black. Blow up the fire until it again burns clear and is free from smoke, then move the article about over the fire and as close as possible to the red-hot coke until all the soot is burned off. Allow the article to cool, and brush off all particles of crocus, soot, etc. Tie on the head of the smoothing tool a covering of parchment, or one or two thicknesses of lasting, and with the bright hammer go over the bronze surface until it is smooth. An acid process for finished work is as follows:—Dissolve in vinegar two parts of verdigris and one part of sal-ammoniac. Boil this solution and skim the surface clear. Add water to the solution until no white precipitate remains at the bottom of the vessel. Now thoroughly clean the article to be bronzed, and immerse it in the boiling solution until the desired shade is acquired; then rinse in water and dry with sawdust. If the solution is too strong, the bronze will not adhere very firmly, and a little friction will remove it; if the article is not well dried a green coating occurs on exposure to air. Both the above methods require practice before the desired colour and permanency can be obtained.

Permanence of Photographic Prints.—If the directions given by the makers of the paper are followed, pure chemicals used, and separate toning and fixing baths, there is little danger of P.O.P. prints fading. It is perhaps in the fixing and washing of the prints that errors are likely to be made. The fixing bath, which must not be in an acid condition, should be at the normal temperature and sufficiently strong; if either of these points is neglected fading of prints may result. The bath should be made with warm water, as there is considerable loss of heat in dissolving hypo, and when the temperature is low the bath does its work too slowly. When the prints are put in the hypo the unaltered silver is changed into silver thiosulphate, which is insoluble, and then into a double thiosulphate of silver and sodium, which is soluble. Unless the bath is strong enough to form the double thiosulphate, stains and fading may result. The proper strength for P.O.P. is hypo 3 oz., water 20 oz. For albumen prints use a 10-per-cent. solution of hypo. The prints must be kept moving while they are in the fixing bath. It is important that after fixing is completed every trace of hypo should be removed from the print. For this purpose a mechanical washer may be used; this keeps the prints moving round the washer whilst the hypo sinks to the bottom and is syphoned off. Or the prints may be transferred by hand backwards and forwards between two dishes alternately filled with clean water. After about forty minutes' thorough washing the prints should be free from hypo. A test, however, should be applied. Put a small quantity of starch into a test-tube and add a few drops of a solution of iodine, thus forming blue iodide of starch. Pour half of this blue iodide into another test-tube, and, lifting one of the prints from the washing water, hold it by one corner and allow the last few drops of the drainings from it to fall into one of the test-tubes. If any hypo is present in the drainings it will turn the blue solution white. Compare the colour of the solutions in the tubes by holding them side by side against a sheet of white paper.

Making Bar Soap.—As a preliminary trial in soap making, try the cold process. Cocoanut oil should be used to the extent of from 25 to 50 per cent. if possible, as it not only rapidly saponifies but appears also to hasten the saponification of other oils mixed with it, and forms an easy lathering soap. For trial, dissolve in 1½ pt. of water ½ lb. of caustic soda (that in hermetically sealed tins for preference); place the lye in a jug. Now raise the temperature of the oils to 110° F., pour into a large bowl, and add the lye very slowly, stirring well with a stick. When the lye has been thoroughly mixed with the oils the mixture may be poured into a mould. An efficient temporary mould may be made by lining the inside of an old box with a piece of old cotton cloth, wetted, and folded in several thicknesses. Pour the mixture into the cloth, cover the box over, and place it in a warm place for from twelve to twenty-four hours. If the mixing has been properly performed, a block of hard soap will be produced, which may be cut into bars with a wire.

Roof Cutting into Side of Dome.—It is required to obtain the proper sweep for the plate that runs up the slope of a roof which cuts into the side of a dome. If the dome is a semi-sphere, then the section of the dome formed by the plane of the roof passing through



Roof Cutting into Side of Dome.

it would be a part of a circle. Produce A B, the plane of the roof (Fig. 1), until it joins the plan at A^1; bisect A^1 B to give the centre O^1, and then draw a line at right angles to the ground line from A to cut the plan at C. The distance A C would be half the width of the section's base. To draw the section, set off a line at right angles to, and on both sides of, A B (Fig. 3). Make A C on both sides of A B equal to A C (Fig. 2), also make A B (Fig. 3) equal to A B (Fig. 1). Then mark off from A, A O^1 on the section, equal to A O^1 (Fig. 1). Use O^1 as centre, and with radius to B draw the arc shown, Fig. 3, and this would be the part to be cut from the plate, so that it would fit the dome.

Making Stannate of Soda.—To make stannate of soda, proceed thus. Melt together 2 parts of caustic soda and 1 part of finely powdered tinstone (native oxide of tin). Add to the melted mass a small quantity of hot water, allow to settle, and pour off the clear liquid; this can be evaporated to form the liquid stannate. On further evaporation the liquid will commence to crystallise, and after cooling the crystals may be strained off, washed once or twice with a little water, and dried. The liquid poured off from the crystals should be evaporated to dryness and added to the next melt; the part insoluble in water may also be added so that there may be no waste. Tin crystals (stannous chloride) are formed by boiling tin with hydrochloric acid until no more will dissolve, and then evaporating and cooling the solution; the tin crystals will then separate out.

Testing the Speed of a Camera Shutter.—A method of estimating the speed of a camera shutter is as follows. Attach to the side rim of a bicycle wheel a piece of tinfoil. Invert the bicycle, place it in the sunshine, and focus this wheel sharply. Put a plate in the camera ready for exposure, and set the shutter at its lowest speed, using as large a stop as possible. Revolve the wheel so that it makes one revolution per second, or fifteen revolutions in a quarter of a minute, and when this speed is obtained let go the shutter. Now make a time exposure on the same image, but on another plate with the wheel at rest. The first plate on development will show a blurred arc where the image of the bright tinfoil moved across the plate. The proportion the movement bears to the complete arc is the speed of the shutter expressed in fractions of a second. To find the degree of movement, measure on the negative showing the wheel at rest the width from side to side of the tinfoil, and subtract this from the extension of the arc. Now ascertain with the compass how many times the remainder is contained in the circumference of the wheel image and the answer is the fraction of a second exposure that the shutter gives.

Mixing Oil-colour Paint.—For painting any surface that has to stand the stress of weather the paint should be of as good quality as possible. For a good oil paint take, for each pound of colour required, ½ lb. genuine white-lead, 1 oz. of patent (paste) driers, or a small quantity of terebine, and mix it to the required consistency with a mixture of raw linseed oil 2 parts, turpentine 1 part. If it is required to dry with a good gloss, replace half the raw oil with boiled oil. If a tint is wanted, work in the requisite quantity of pigment ground in oil; ochre for cream, Venetian red for salmon, middle Brunswick green for pale green, ultramarine for grey, burnt sienna for a reddish buff. For dark coloured paints, replace the white-lead with a similar quantity of pigment ground in oil, and use more boiled oil, or else add a little good oak varnish.

Determining Superficial Surface of Steam Pipes.—The rule most usually adopted for determining the number of square feet of heating surface of different sized steam pipes is to calculate that a foot length of 4-in. pipe has a superficial, *i.e.* square, foot of surface. Then the areas of other sizes can be readily estimated. A 1-in. pipe, for instance, has one-fourth of a square foot of surface per foot run, or a square foot to 4 ft. run. This would also apply to bends, fittings, and other hot parts of the installation. These calculations are based on the interior diameters of pipes. Often the exterior is taken, by which a 1¼-in. pipe, 1 ft. long, would be said to have half a square foot of surface, because it is of 2 in. exterior diameter (nearly). This, however, is not a correct way, for it gives a certain size of pipe a variable super surface according to the thickness of the material of which it is made, whereas the thicker material would decrease heating efficacy rather than increase it.

Manufacture of Condensed Milk.—In making condensed milk, milk is mixed with sugar and then evaporated by steam in a vacuum pan, in which a reduced pressure may be kept in order that the milk may lose its water at a much lower temperature than the boiling point under ordinary pressure. The temperature employed is about 100 deg. F., and the vacuum is kept as good as possible. The plant required consists of one or more vacuum pans, a boiler for supplying steam and for pumping, suction pumps, etc., and canning outfit.

Making Sugar Figures.—Sugar figures are made by placing about 2 lb. of sugar in a pan and adding barely sufficient water to cover it and a little cream of tartar; melt down by a gentle heat, and boil to the degree known as "ball," *i.e.* about 250° F. Rub the pan briskly with a stick until the sugar thickens, then fill the moulds as quickly as possible through a funnel. Objects that are flat on one side may be moulded in starch powder, shaped objects in plaster-of-Paris moulds, while large objects are usually made hollow, the moulds being filled with the sugar, and the unsolidified portion being poured out after a few minutes.

Hot Box for Photo Negatives and Lantern Slides.—An aid in varnishing lantern slides made from negatives or in varnishing photographic negatives themselves is illustrated by Figs. 1 to 5, the letter references in these figures being similar. It is usually advised to heat the slide before a fire or lamp before flowing the varnish on and off; in too many cases this means unequal heating and burnt fingers. With this hot box it is only necessary to lay the slides on the top, fill the box with water (boiling or cold), and light the spirit lamp, and in a short time the slides will be heated equally all over. After varnishing, they are left on the top until thoroughly hard and dry. The box consists of eight pieces of wood screwed together, supporting a zinc box with an iron top. The front and back pieces A and B are each 17 in. by 6 in. by $\frac{3}{4}$ in. The two side pieces C and D are each 14 in. by 6 in. by $\frac{3}{4}$ in. These four pieces are mitred at the angles, chamfered on the top edge, and screwed to the angle pieces E, F, G, and H, each 4 in. by 1 in. by 1 in., on which rests the zinc box. The front piece has an opening cut in it to admit the lamp L, and the back piece has two pieces cut out to admit the water inlet J and the steam vent K. The hot box is 15 in. by 12 in. (this allowing $\frac{1}{4}$ in. space between it and the wood) and 2 in. deep. It is made of stout zinc with an iron top $\frac{3}{16}$ in. thick soldered on, forming a level bed for the slides. The water inlet discharges on the floor of the box, and the steam vent is taken from under the top plate as shown. Steam issuing from the water inlet indicates that more water is needed. This box will take one dozen lantern plates and, as has been stated, is equally as well adapted for use in varnishing ordinary photographic negatives.

FIG. 1

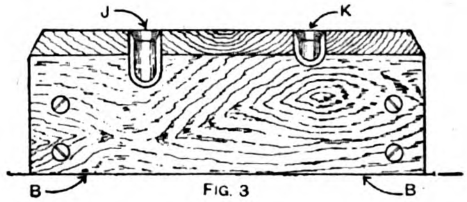


FIG. 3

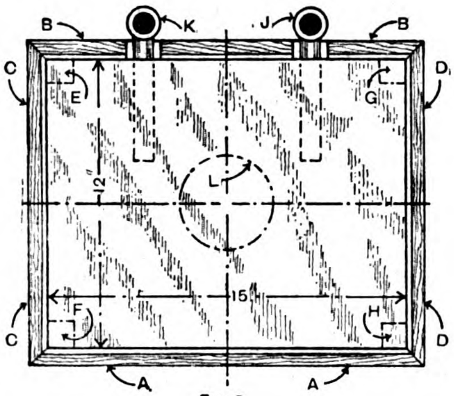


FIG. 2

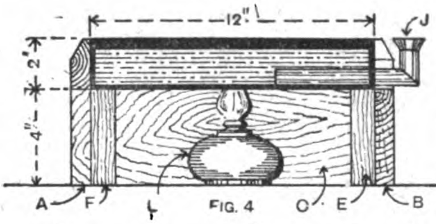


FIG. 4

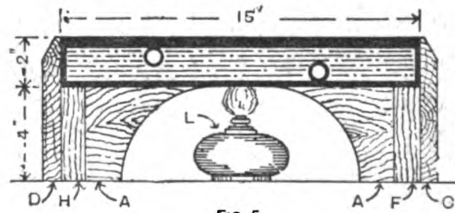


FIG. 5

Hot Box for Photo Negatives and Lantern Slides.

Dry Rot in Floor Boards.—The conditions most favourable to the germination of the spores of the dry rot fungus and to its subsequent growth are (1) a still atmosphere—no draught, (2) a little moisture—not too much, (3) a little warmth, (4) a little ammonia. An air brick on one side of the house is of no use without one on the other side, and both together are useless without holes through the cross walls to allow of a through draught. If the joints of the floorboards are open, a little ventilation may be afforded by currents of air finding their way through. If the upper face of the boards is exposed, the fungus cannot thrive on it; its ravages will be confined to the lower side of the floor, and it will make its way through the boards slowly. Obviously that part of the floor which is covered with loose-textured carpet has the better chance of holding out, but that which is covered with oilcloth, and thus cut off above and beneath from all supplies of fresh air, has everything against it. As regards the moisture, the fungus is greedy for this, although it has to take its supply in very minute quantities from the air or from objects with which it is in contact. So much moisture, indeed, does it succeed in taking in that it has to discharge an excess, which hangs on its surface in clear sparkling drops, hence its name, *Meruleus lachrymans* (lachrymans being the Latin for weeping). The remedy is to remove the whole of the floorboards, joists, and other timbers. Every vestige of fungus in any form should be scraped or brushed off the brick or plaster work. Examine the skirting, and remove any that has any suspicion of the growth on it, even the white mould. Clear the ground and take off an inch or two of its surface to ensure getting rid of every trace of the disease and its spores. In some cases an application of fresh limewash to the surface of the walls has prevented further development. Vitriol has also been applied with good effect. If not too expensive, cover the ground with hot lime concrete. Break holes through the cross wall, preferably at the ends, as the air is apt to become stagnant in the corners. Put at least one air brick at the back of the house, and above all things see that the new timber used is not infested with incipient dry rot before it is used.

Action of Steam in Locomotive.—A locomotive usually, though not always, has a pair of simple engines. These act as ordinary horizontal steam engines, steam being admitted and cut off according to the notching-up. It then expands to fill the cylinder, pushing the piston before it. Just before the end of the stroke the exhaust port opens and steam is exhausted from one side of the piston up the chimney, its pressure, which now is a back pressure or resistance, falling and the piston being pushed by fresh steam in the opposite direction. The motion of the piston is transmitted through the piston and connecting rods to the crank, and thence to the wheels.

A Simple Level.—With the simple level illustrated the proper grade and levels for drains, ditches, roadways, concrete floors, foundations for houses, and for bridges, etc., can be laid out. In fact, all sorts of levelling can be easily and readily done with this instrument. Fig. 1 shows an elevation of the complete instrument; A is a builder's ordinary level fitted with a pair of Stanley's improved level sights B B. The level is placed on a table C that can be set level by means of four thumbscrews D and sighted in any direction. In the figures, E is a triangular block of hardwood to which are fastened the parallel plates C, and also the three legs by three screws G; H is a small brass eye screwed into the centre of the underside of the triangular block to suspend a plumb-bob if it should be required to place the instrument over a point. Fig. 2 is a section showing dimensions of the parallel plates. The top plate should be of two pieces glued and screwed together, cross-grained to prevent twisting. In the centre is fastened, by means of a brass screw, the ball J for the ball-and-socket joint. In the centre of the top piece of the bottom-plate a hole is made to fit the ball to

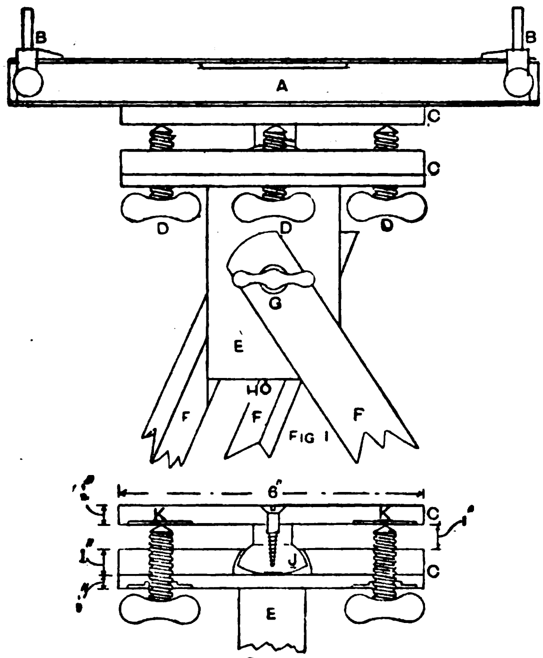


Fig 2

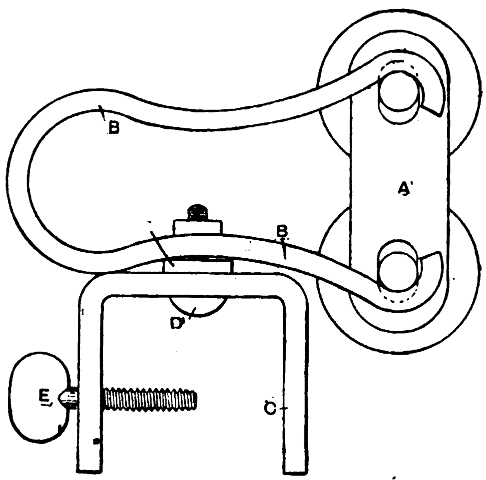
A Simple Level.

form the socket of the joint. Before glueing the two parts of the bottom-plate together, the triangular block of hardwood (3½ in. long with 2-in. sides) must be screwed to the bottom-piece on the under-side. The thumbscrews on the lower plate are equally spaced ¾ in. from the outer edge. On the under-side of the top-plate over the point of the thumbscrews, and for them to bear against, small brass plates K K, Fig. 2, should be fixed. The levelling staff can be made by painting the divisions on a strip of ½-in. board, or, if preferred, papers printed with the divisions can be obtained and pasted on the board. The instrument is set up and used in the same way as an ordinary dumpy level.

Cod Liver Oil Emulsion.—To prepare an emulsion of cod liver oil, triturate together in a mortar 2 oz. of gum arabic and 3 oz. of water, then add 8 oz. of cod liver oil; slowly beat the whole together until a smooth cream is formed. Now dissolve 128 gr. of hypophosphite of lime and 96 gr. of hypophosphite of soda in 3 oz. of water, and beat this up with the other ingredients. To disguise the flavour of the oil, add 1 oz. of sugar syrup (1 part sugar to 1 part water) or glycerine, and a few drops of essence of almonds; mix these with the other ingredients as before.

Working and Polishing Ebony.—Ebony must be selected for colour, grain and texture first, as these vary very much; the cuts near the bark or outside surface often contain sand and other foreign substances which dull the edges of the tools employed. Ebony may be turned in the lathe, using, for small work, two gouges, one for roughing out and the second for finishing. The tool is held above the centre, a high speed is employed, and light cuts are continually taken, the finishing cut leaving a dead polish which only needs a handful of turnings held against the work while revolving to brighten it. A piece of blanketing with a few drops of linseed oil finishes the work. More elaborate forms of ebony work are cut with a revolving drill in the lathe; and there is also an automatic lathe for turning out handles in quantities. Ebony in the flat is first sawn with a fine circular saw into slabs or veneers. Further shaping may be done with a hand or power fret-saw. The finishing is done by fine rasping and filing, and the polishing is begun by scraping with a sharp knife or a proper scraping tool, always scraping in one direction; the polishing is completed by dollying off on a felt dolly driven by power, the dolly being kept moistened with linseed oil.

Making a Wringing Machine.—A simple wringing machine can be made in this manner. Obtain two indiarubber rollers mounted on spindles; remove the cogs, as these are not used. Also obtain two slotted plates as A (see sketch), made from 1¼-in. by $\frac{3}{16}$-in. iron; the slots in the plates must be of a size to fit easily on the spindles of the rollers, the distance apart being regulated by the diameter of the rubber. Also make two



Making a Wringing Machine.

springs from 1-in. by $\frac{3}{16}$-in. steel, shaped something like B. Two clips, as C, will also be wanted; the top part must be drilled to take a bolt D, a corresponding hole being made in the two springs. One leg of each of the clips must also be drilled and tapped, and a thumbscrew fitted, as E. To fit the parts together, first place the two roller spindles in the slots in plates, then spring on the impression springs, one on each end. Now measure the distance from centre to centre of the two springs, and drill a piece of flat iron so that it will fit between the springs and the clips, as shown at F; this will keep the springs rigid sideways. The clips with thumbscrews are for fixing the machine to the washtub, and, being fixed by one bolt only, will swivel round so as to be used at either angle. One of the roller spindles should be squared or threaded for a winch handle. All the ironwork must be well painted or given two good coats of bath enamel.

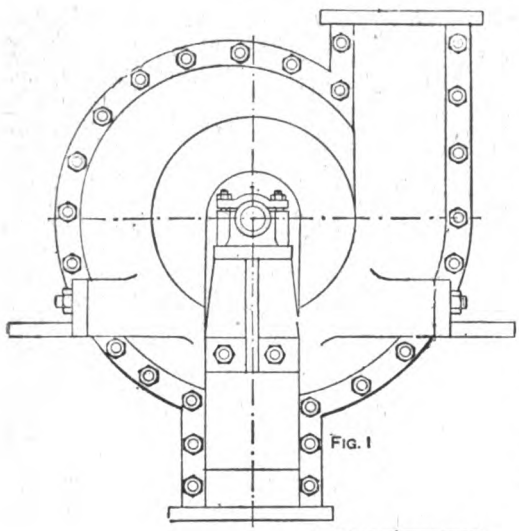
Bending and Canvassing Landau Panels.—If nailed flat across the boot-side, with the top edge rounded down, or overhung to form a bead in the neck, the panel should be bent and canvassed before fixing. This must be done very carefully, or the panel will split. To canvass a panel after it is bent, place it on a wide board, round side up, and drive in a draw-bore pin at each outside corner; this will prevent the panel sagging in the centre, which would split it. If the panels are boxed in flush, canvass them after they are pinned in. Quarters and back panels should be canvassed a day or two before they are wanted; there is then less danger of breaking them when fitting them in the grooves. This only applies to panels with a slight single sweep; where there is a return or chair-back sweep they must be canvassed after they are in.

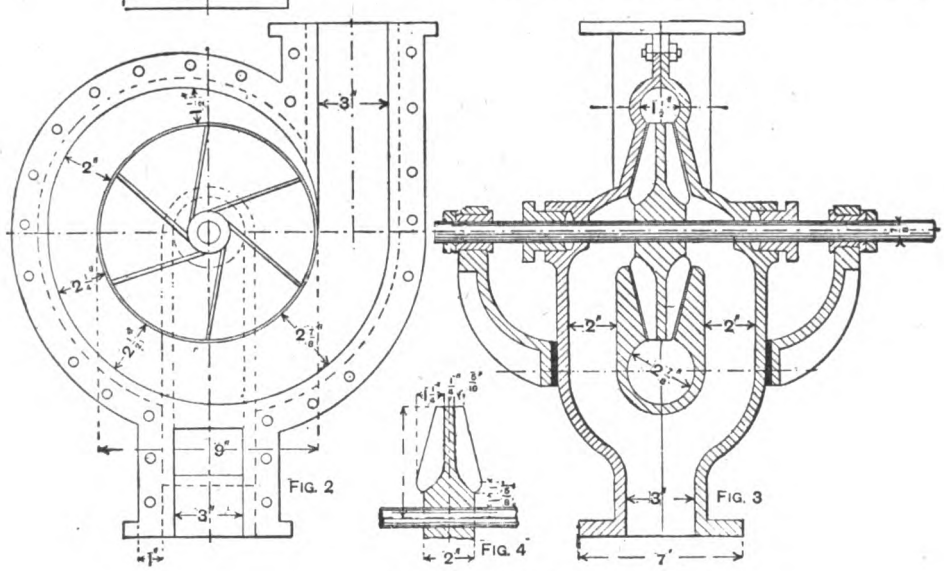
Noise in Hot-water Tank.—It is sometimes the case that a hot-water apparatus works well until the water reaches the boiling point, when a rumbling sound at the tank is heard. This noise is merely the sound of the water boiling. The remedy is to regulate the boiler damper so that the water shall not boil. When the noise occurs, it can be silenced by drawing off some water at one of the hot-water taps. This causes cold water to flow into the tank and reduce the temperature. The fact that water has a tendency to boil indicates either the use of a more powerful boiler than the apparatus requires, or want of attention to the damper. The latter is the more probable fault, causing the boiler to become overheated and fuel to be wasted.

Making a Round Net.—In netting a round net, the loop upon which the first meshes are made can be afterwards tied up tightly to form a bottom. Or the first meshes can be cut away, the short cut ends pulled out through the inner bights of the second row (that is, the now inner row of whole meshes), and a grommet worked if a circular hole is wanted; or the ends can be drawn together and tied with a separate piece of string. To prevent crowding of meshes at the bottom of a round bag it is usual to commence with about six meshes for the first row, making the first as small as possible at the tapered end of the mesh, the last two being worked loosely at the broad end; the first stitch of the second row will then be nearly regular in size, and in the third row all will be even. But in this row, if the net was commenced on six meshes only, stitches must be added; to do this, work two meshes on each loop of the former row, or two on every other loop, according to the shape of net required. In this way add meshes in any row where it is desired to increase the diameter. It is not often wished to decrease the diameter of a round net, but if required to do so, pick up two meshes on the needle at once and hitch together in one; each time this is done one mesh less will, of course, follow in the succeeding row.

Manufacture of Calcium Carbide.—Calcium carbide may be made by heating an intimate mixture of finely divided coke or carbon and lime in an electric furnace, using a current of from 4,000 to 5,000 amperes. The furnace used by Willson in America consists of an outer coating of firebrick lined with carbon or graphite, a tap hole being placed near the bottom; the furnace is covered with carbon plates, through which passes a thick carbon rod reaching nearly to, but not touching, the bottom of the furnace; the carbon rod and the inner carbon layer are connected to the dynamo. 1,200 lb. of fine coaldust and 2,000 lb. of quicklime yield 2,000 lb. of carbide in twelve hours.

Centrifugal Pump.—Herewith are dimensioned drawings of a centrifugal pump designed to lift 150 gal. per minute at 20 ft. head. To enable the volute to be correctly formed the case is in two halves. To avoid end thrust and to ensure an even balance of the disc, the inflow takes place on each side, each inlet having a diameter of 3 in. Fig. 1 is a side elevation and Fig. 2 one half of the case showing the depth of the volute and disc with angle of vanes. The volute, to obtain a good flow, must increase evenly to its discharge. The discharge pipe should increase in area to reduce the velocity considerably. The flange of the casing is 1 in. wide, drilled to take ½-in bolts. The diameter of the disc is 9 in., and is arranged for six vanes, having an angle of 80° at the circumference. The shaft is ¾ in. diameter, and the approximate speed of disc is 650 revolutions per minute. Fig. 3 is a section showing side inlets, disc, and brackets, and Fig. 4 is a section of half of the disc showing dimensions of the vanes.





Centrifugal Pump.

Glazing Clay Tobacco Pipes.—A simple lead glaze is generally used for clay tobacco pipes. The following may be taken as examples. (*a*) Lead oxide (litharge), 45 parts; sand, 35 parts; common salt, 6 parts. (*b*) White lead, 53 parts; Cornish stone or felspar, 16 parts; white flint glass, 5 parts. The glaze may be melted in a crucible, and the stems of the pipes (which should have been previously burnt) dipped in. For green colour, use 5 per cent. of oxide of copper; for red, 5 per cent. of red oxide of iron.

Polishing Turned Wood.—Soft woods may be turned so smooth in the lathe as to require no other polishing than that produced by a few fine turnings or shavings of the same wood applied while revolving in the lathe. Mahogany, walnut, and some other woods may be polished by the use of a composition made by dissolving by heat so much beeswax in spirit of turpentine that the mixture, when cold, shall be of about the thickness of honey. Or instead, dissolve 1 oz. of sandarach in ½ pint of methylated spirit, and mix the solution gradually with 1 oz. of beeswax in sufficient turps to make it into a paste. Apply with a woollen cloth whilst the work is still in motion, and polish with a soft linen rag or chamois leather. The work thus treated should have a highly varnished appearance. Hard woods may be readily turned very smooth, and fine glasspaper will suffice to give them a very good surface; a little linseed oil may then be rubbed on, and a portion of the turnings of the wood to be polished may then be held against the article while it revolves rapidly. By this means a fine gloss will be imparted.

Scenting Powder.—To perfume a powder with otto of roses, place it in a mixing machine, *i.e.* a revolving cylinder or barrel provided with ribs internally. Spray the scent into the powder and set the machine in motion until the scent has been disseminated through the whole. To disseminate the scent better, dissolve 1 part of the otto in 6 parts of spirit of wine, and use the mixed essence in place of the pure oil.

Making Silver Mounts for Tobacco Pipes.—In making an ordinary pipe mount, a plate of silver has to be prepared to fit tightly round the two pieces of the pipe to be joined by its means. The easiest way to obtain a pattern of this plate is by wrapping a piece of smooth paper round the place on which the mount is to go, and very carefully cutting all the surplus away with a pair of scissors until one thickness of the paper is all round the pipe. If this is done carefully and due attention is paid to the straightness of the soldering seam and of the ends, the silver can be cut to fit exactly. The plate must be flattened, and then turned up into a tube quite free from bruises or kinks. For this is required a "triblet," which is a tapering piece of smooth round iron or steel; a bending block is also required. A mallet also may be necessary if the silver is thick; thin metal will come up by the pressure of the hand almost, and may be worked with a pair of half-round pliers in place of the block and mallet. With a knife or a scraper made from a three-square file, make the edges to be soldered together quite level and true with each other; see that no burr from the file is left on the metal when tying with wire. Should the mount be long, it is desirable to file small nicks in the edges that form the seam *a a* (Fig. 1), so that the solder may hold better; the seam will not be so likely then to open during the subsequent operations. When fitted, the tube is tied with iron binding wire so that the edges remain in the proper position whilst soldering. Thin wire should be used, as thick wire on cooling and shrinking may bruise the work. The tying of the wire is not a difficult job, but with a very tapering mount means have to be taken to prevent the binding wire slipping down (see Fig. 1). In soldering, which is the next process, brush the flux on the edges to be united, which previously should have been scraped clean. The flux is borax rubbed up in water. Lay some pallions (small pieces) of silver solder along the seam, and with a gentle heat from the blowpipe flame evaporate all moisture. Then, if the solder has not been shifted, apply the full heat. When cold, pickle in a mixture of 1 part of sulphuric acid and 40 parts of water, and file off any pieces of unflushed solder. The mount now is sure to be more or less out of shape, so it has to be trued on the triblet previously mentioned with a smooth-faced mallet. The work could be more easily done in a lathe, which would also be useful in the subsequent polishing. If the metal is so thin that the triblet and mallet or hammer are of little service, use a ribbed burnisher (Fig. 2), with which it is quite possible to rub the thinnest of collars true and smooth. The burnisher may be from 7 in. to 10 in. long, 1 in. wide, and $\frac{1}{16}$ in. thick, and can be made from an old flat file. The ribs or ridges should be quite smooth, and should be of the size shown in Fig. 2. When the mount is in shape, and fits the pipe, it will have to be smoothed and polished. Remove hammer marks, etc., by filing, and not by the use of glasspaper or emery-cloth; by the latter means the corners are rounded instead of being left sharp. The next thing is to polish the mount. The principle underlying most polishing processes is a simple one. It is the application by friction of abrasive materials in stages of gradually increasing fineness. If that is understood, it will be an easy matter to make shift with materials that may be handy, though those mentioned here may be obtained in small quantities at oilshops and of dealers in jewellers' materials. As the mount to be polished may be thin, and therefore likely to get out of shape, a piece of wood should be fitted to it, and this will both support it and allow it to be handled with comfort. First is used a stick of water-of-Ayr stone with water, a damp sponge being employed to remove the mud-like stonings as they are produced. This is followed by pumice powder and oil, and this by crocus and oil (or rotten-stone or Tripoli powder and oil). These may be applied by means of buffs made by glueing strips of buff leather to pieces of wood. Next softly brush the mount with damp whiting, and then wash it in hot soda and water to remove all the contained grease in the polishing materials. The final polish is given with rouge, applied by a buff at first, and then by the palm of the hand or the ball of the thumb. Wash off all rouge, and the mount is then ready for fixing on. It is important in using the rouge that the hands, rouge, and everything by which the mount is touched be quite free from grit. Jewellers' rouge is not that sold as face powder, but is peroxide of iron specially prepared. The best quality has a red colour having a decided purple tinge. Rouge varies in colour from the one mentioned to a deep red.

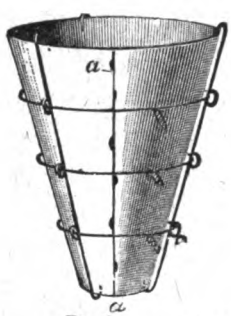


FIG. 1

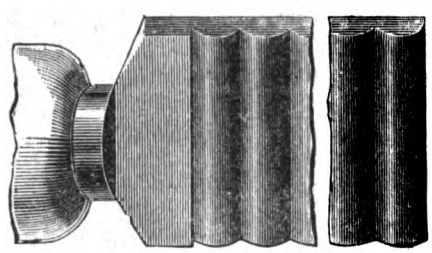


FIG. 2

Making Silver Mounts for Tobacco Pipes.

Ball Clay for White Enamel Body.—Ball clay used in the preparation of white enamel body may have a composition of Cornish stone, 40 parts; Cornish clay, 10; and blue clay, 20. Or Cornish stone, 80 parts; Cornish clay, 20; blue clay, 40; and flint, 20. Or Cornish stone, 100 parts; Cornish clay, 20; blue clay, 18; and flint, 40. Or Cornish stone, 30 parts; Cornish clay, 10; blue clay, 17; and flint, 8. The colour can be rendered bluish-white by the addition of a little cobalt blue. The non-fusible materials added to the glaze are barytes, bone ash, and oxide of tin; the latter is put into nearly all enamel glazes. The clays are mixed with excess of water, passed through a fine sieve, and then boiled down to a paste. Here are recipes for white glazes. White glass, 100 parts; white sand, 50; salt, 40; litharge, 120; and oxide of tin, 60. Or lead and tin ashes, 44 parts; sand, 44; soda, 2; common salt, 8; and red-lead, 8.

Pressure of Water.—A pressure is often stated as being equal to so many inches of water. If the height of water were 1½ in., the expression would mean a pressure equal to that caused by a column of water 1½ in. high, or, in other words, the weight of such a column. On the square foot this will mean a pressure of 7·794 lb.; on the square inch, $\frac{1}{144}$ of this, or ·054 lb. The higher pressures are usually measured by a Bourdon or other pressure-gauge; the light pressures are ascertained by inserting a tube and measuring how many inches of water in the tube are required to balance the pressure—thus the term, a pressure equal to so many inches of water.

Cement for Jointing Hot-water Pipes.—Cement for making joints in hot-water pipes contains 80 to 100 parts, by weight, of iron borings (which must be pounded if coarse), 2 parts of flour sulphur, and 1 part of powdered sal-ammoniac. The ingredients must be well mixed and moistened with water, this being done from half an hour to two hours before use, according to the weather. The joint is first caulked a little more than half full of yarn, then finished with the prepared borings. The borings must be caulked in carefully, or the socket will be split as the joint sets, for the borings expand a little in setting.

Paint Blistering on Front Door.—The blistering of paint is caused by the presence of water either in the paint or in the substance to which the paint is applied, greatly aggravated by the action of the sun upon the door. The old paint should be burned off with a spirit lamp, and the surface of the door well rubbed down with glasspaper. Then give a priming coat made of 2 lb. of white lead, 3 oz. of red lead, and 3 oz. of yellow ochre (note that the red lead is a drier). Thin with one-third raw oil and two-thirds turpentine. Finish in any desired colour, using as little oil as possible, or turpentine instead of oil. Varnish on a dry day with a good varnish. It is better not to buy the varnish from an oilshop. Clean all water out of the brush before painting; a dirty brush—*i.e.* one with water in it—is often the cause of paint blistering.

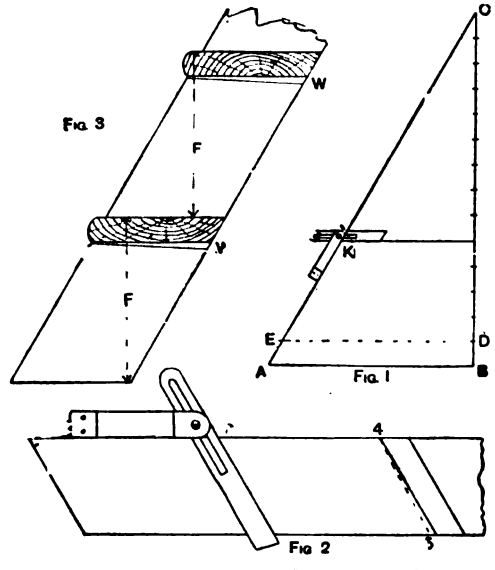
Gilding and Silvering Leather.—Gum mastic in fine powder is first dusted over the surface to be gilded. An iron or brass tool bearing the design upon its face is then heated to the proper temperature and gently pressed on a piece of leaf gold, which adheres to the tool. On pressing the tool lightly to the surface to be gilded the mastic softens and retains the gold. The loose gold and powdered mastic are then brushed off. Gold leaf will adhere to leather without mastic, but not so firmly as with it. To apply tinfoil or silver leaf, place on the part of the leather to be covered some size or white of an egg, and after pressing down the metal and drying, wash over with gold-colour lacquer. The following tools, etc., will be required. A long, thin knife, straight, and not too sharp; a wide thin brush, with camel hair about 3 in. broad; a pad for cutting the gold leaf, and a dabber, a small soft ball of cotton-wool enclosed in a square of muslin with its edges drawn together and tied to form a handle, and wheels and stamps of the shapes required.

Cleaning Bronze Chandelier.—To clean a bronze chandelier that is corroded by damp, take the chandelier to pieces and carefully remove all pins, screws, and other iron parts. Then place about ½ lb. of potash in 1 gal. of water, and in this boil off all the old lacquer. Allow the various parts to remain in the solution for about twenty-five minutes; then take them out and well wash in clean cold water. They should then be dipped in aquafortis, and allowed to remain sufficiently long to become bright. Each part should be held in the acid bath by means of a copper wire twisted round, or by holding with a small pair of brass tongs. Then well rinse in several changes of clean cold water, either by having several vessels or by well rinsing in running water. Transfer to the sawdust tub, dry, and relacquer.

Making Warner Wheels.—Procure a pair of Warner stocks and set of spokes to match; these are supplied with the iron band mortised the exact size of the bottom part of the spoke just above the shoulder, which is sunk or housed in full ¼ in. from the face of the iron band, the shoulder of the spoke resting on the wood centre of the stock. To fit the spokes into this part, the mortises already made must be eased out to ensure a good fit to the tenon of the spoke. Before driving the spokes into the stock, clean off the front end of the stock quite level, and fix with a coach-screw, dead in the centre, a strip of wood called a set-stick; this must be perfectly straight and parallel, 2 in. wide by 1 in. thick, and a little longer than the spoke. Measure the distance from the front of a mortise to the set-stick. In the set-stick, at the height of the shoulder of the spoke, bore a hole, and insert a piece of cane or whalebone, keeping it as much shorter than the distance from the mortise at the bottom as the dish required in the wheel. In wheels of this description ¼ in. is sufficient when made, as they go more in tyreing. Drive all the spokes in, so that they touch the peg in the set-stick. To get the tongues all alike, plane a small piece of panel board to such a width that when held against the inside of the set-stick the opposite edge of the board comes on the spoke full ¼ in. Mark all round by this. Now set off the size of the tongue with compasses, and cut down, sawing the shoulders on the front and back only, pulling out the sides with the draw-knife. In large firms, the tongues are made with hollow augers, which cut a square shoulder right round the spoke; but this method is not so strong as that described above. In cutting in the felloes or rims, see that the joints are square and true, and bore the dowel holes parallel with the face of the felloe; also bore all the holes for the tongues exact, as when they are bored through at different angles it is impossible to get a true face on a wheel; undue strain is also put on the tongues of the spokes, so that they soon break off short at the shoulder.

Darkening Cement for Pointing.—For darkening cement to be used for pointing brickwork bricklayers use smithy ashes, which can be procured from any blacksmith. The ashes should be ground or crushed to the size of sand (not crushed to powder) and used instead of sand, or sometimes a small quantity of sand is mixed with the cement and cinders. The wearing qualities of the cement are not improved by the use of cinders. Lampblack is occasionally used as a colouring agent, and when it is used sparingly the wearing qualities of the cement are not lessened.

Setting Out the Sides for a Step Ladder.—In setting out the sides for a step ladder, first set up the vertical height C B (Fig. 1) to a convenient scale, and divide for the number of steps required (the usual distances, as shown at F, Fig. 3, being from 7 in. to 9 in.).



Setting Out the Sides of a Step Ladder.

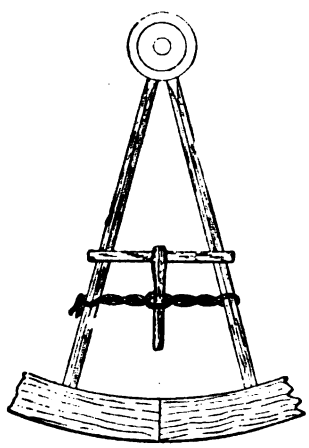
Next set off the splay A B (Fig. 1). Join A to C; this will be the pitch of the sides. Draw a horizontal line and set a bevel to this and the pitch line as shown at K (Fig. 1). Now draw a horizontal line D E, then A E will be the distance apart of the treads measured along the edge of the strings (sides). Set a pair of compasses to this distance, and step them along as near as possible to the outer edge of the string and mark off with bevel as shown at Fig. 2. Fig. 3 shows the usual section of steps which are often wedged into the housing of the string as indicated at W. This would have to be allowed for as shown at 4, 5 (Fig. 2).

Bricks for Cupola of Furnace.—For lining cupolas for blast furnace or other cupreous slags, nothing is better than Dinas bricks unless it be ganister bricks as made at Lowood near Sheffield. The only difference between the two is the quantity of silica contained in each. A good Lowood brick has assayed out at the following proportions: Silica, 96·4; alumina, 1; lime, 1·25; sundry oxides, 1·35; while a best Dinas brick from Wales assayed out as follows: Silica, 95·75; alumina, ·4; lime, 3; sundry oxides, ·85. Ganister bricks do not, on cooling, crack so quickly as Dinas bricks, because Dinas bricks, having a higher percentage of silica, are practically infusible and unaffected by the great heat. The bricks, either Dinas or ganister, should be set in the very thinnest of ganister cement, the usual plan being to dip the brick in very thin cement, and when the work is finished to slurry over the surface with thin cement.

Determining Discharge of Water through Pipe.—The water velocity in feet per second corresponding to a given pressure can be calculated by multiplying the square root of the pressure in pounds per square inch by 12·19. The velocity being thus obtained from the effective pressure, multiply it by the area of the pipe in square feet and by 6·23 to determine the quantity discharged in gallons per second.

Lines on Picture Mounts.—There are several methods of placing gold lines on mounts for pictures. First make small pencil dots where the lines are to end. If gold powder is used, make the lines with a strong solution of gum, and when this is "set" breathe gently on the lines, and dust on the powder. White lines are made by means of white ink, a heavy mixture of Chinese white. A common pen kept well charged will answer admirably as a means of applying the ink.

Putting Felloes on Wheels.—Herewith is an illustration of a device for pulling towards each other the spokes of cart and carriage wheels. This dispenses with the lever and other tools used in some methods of doing this work. Having fitted the spokes and holed the felloes to suit, tie the ends of about a yard of tough cord about ½ in. in diameter to form a ring, which is slipped over two spokes, and then twist this with the handle of a hammer until the spokes come to position. Then by a piece of



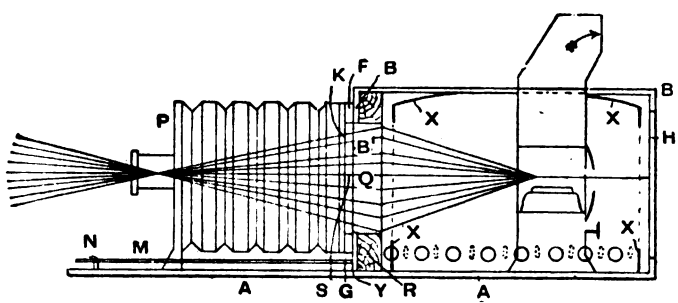
Putting Felloes on Wheels.

lath, as shown in the figure, keep them up as long as required; by removing the hammer and undoing the running knot the appliance is ready for another pair.

Removing Paint from Floor Boards.—Freshly slaked limewash, to each bucketful of which is added at least 2 lb. of common washing soda, makes a good paint remover. It should be applied by means of common fibre brushes—not bristles; several applications may be necessary to remove the paint. The latter should be removed by scraping when soft, then swilled off with plenty of clean water, and finally brushed over with common malt vinegar. It is doubtful whether, after this treatment, the boards will be sufficiently clean to be left as white without bleaching. For the latter, frequent applications of oxalic acid—2 oz. to 1 pt. of water—will generally suffice. Partially to remove the black so as to gain an old oak effect, try equal parts of turpentine and methylated spirit. If this can be made hot with safety it has greater penetrating power. Liquid ammonia is also effective, but is best handled if diluted with an equal bulk of water.

Willis's Odontograph.—The Odontograph, invented in 1838 by Professor Willis, has been used to determine the radii of arcs of circles that shall approximate to the epicycloidal and hypocycloidal curves which should be used if perfect forms are wanted for the teeth of wheels. The instrument consists of a scale and a table. The first may be set out as follows on a piece of cardboard about 14 in. high by 7½ in. broad. At the right-hand edge, and about 2½ in. from the base, take a point. From this point divide the edge into lengths of ½ in. and number the divisions 10, 20, 30, etc., both above and below the point first marked, which should be numbered 0. Then subdivide each ½-in. division into ten equal parts, and from the point first marked (0) set off a line towards the base at an angle of 75° with the vertical. The tables on the instrument show the place of the centres of the arcs of flanks and faces upon the scales for wheels with teeth numbering 12 to 150, and for racks, the pitches varying from 1 in. to 3 in. Other pitches may be found proportionately; thus, for a ½-in. pitch, take out half the table value for a pitch of 1½ in. To use the instrument, one half the pitch is marked along the pitch circle of the wheel to be set out at each side of a radial line. From the two points thus found radial lines are set off. Then the sloping line of the instrument is placed so as to coincide with one radial line, with the edge of the scale over the point on the pitch circle. Then consult the table of centres for flanks of teeth; the number in the table, which varies with the pitch and the number of teeth, shows the point on the scale line above 0 at which the centre of the curve for the flank of the tooth is situated. Similarly for the centre of the face of the tooth set the sloping line on the other radial line with 0 on the pitch circle. Then the table shows the position of the centre on the scale measured downward from 0.

How to Make an Enlarging Lantern.—Below are particulars on the construction of an enlarging lantern. Make a baseboard A, and to this attach the frame B of three sides, with a circular opening in front for a condenser at B¹. Above and below this opening fasten grooved rails F and G to take the sliding negative frame. Join up four mitred pieces to form a frame K, and make the lens-board P. Connect the two with bellows. Bore a hole through K and P to take a brass rod M. Fasten K to F and G, and fix a turn-pin of stout wire at N to clamp the rod M. Fit up the negative frame



An Enlarging Lantern.

to go in S, with an opening 4 in. by 3 in. and 4½ in. by 3½ in. rebate. Sink the rebate deep enough to allow of the turn-buttons which hold the negative coming flush with the surface. The condenser Q is fitted in a block R. Inside B is a second frame X of Russian iron. The holes in this (see dotted lines) are not opposite those in B, so that ventilation without outside light is secured. Short rails are fitted on A, between which the lamp with reflector runs. A four-wick paraffin lamp will be best. Fit a door H. The base is hinged at Y. This lantern could also be used as a magic lantern.

Repairing Broken Rib of Ivory Fan.—The mending of the end rib of an ivory fan containing a fracture about an inch long, is a rather difficult job, as the joining up must be done from the back. Procure a thin veneer of ivory 2 in. long and rather wider than the rib of the fan. Scrape the surface of the veneer and the back of the fracture and fasten together with cement. When set, dress off the sharp edges with a file, and reform the edges of the carved surface by filing and scraping, taking particular notice that the strengthening piece does not cause the fan to bulge when shut up. If the rib is saw-pierced as well as carved, the holes may now be drilled to admit the saw, which must be carefully worked round the original piercing. A more substantial job, if the fan is valuable, would be to procure a veneer of African ivory about ¼ in. thick, the carving and dressing of which would bring it down to ⅛ in., the relative thickness of the end ribs. For convenience of handling, this veneer may be tacked down by the four corners on a flat piece of wood. The design may now be drawn on the veneer with pencil and the pattern cut with sharp gravers such as engravers use. To get the stuff out clean and smooth, each cut must be repeated till the proper depth is obtained. If the work is merely an incised pattern, filled in with either black or red pigment, the engraving is done with a well-whetted lozenge graver, the work being dressed off when the engraving is done and the filling set by brushing with wet whiting and then with a softer brush and dry whiting to give the finishing polish.

The Preparation of Kaolin.—Kaolin or China clay is the basis of porcelain and many pottery clays, and is produced by the decomposition of felspar. Kaolin occurring in the position of the original felspar is called residual kaolin, and frequently it happens that this is carried away by the streams and deposited as sediment in a distant locality, when it is known as transported or sedimentary kaolin. The residual kaolin is likely to contain fragments of crystalline quartz, mica, and undecomposed spar, with smaller quantities of other minerals; while the transported kaolin is likely to contain iron oxide, lime carbonate, and other impurities intimately diffused with it. The residual kaolin furnishes the purer grade, as its impurities may be washed out; whilst the impurities in the sedimentary kaolin are not of such a nature as to be washed out. The common method of mining kaolin in the United States is by means of vertical shafts 25 ft. or 30 ft. in diameter, lined with pieces of wood, each 3 in. by 10 in. or 12 in. by 24 in. The ends are bevelled, so that when the pieces are laid end to end around the sides of the vertical shaft they form a strong wall capable of resisting the great pressure from the clay. As the shaft is sunk, the walls are added to by building from below. Sometimes the clay is mined from open pits, and in a few instances it has been obtained from underground galleries by using heavy timbers, but in most cases the shafts lined with wood are found to be the safest and most economical method. The different methods of washing the kaolin to remove the coarse impurities are all based on the same principle, that of flotation. The material is thrown into water, and the particles of the clay, being finer and lighter than those of the impurities, remain longer in suspension; hence it is only necessary to increase the length of the troughs through which it is carried or to decrease the rate of flow, or both may be done, to get the required degree of fineness in the kaolin, and remove practically all the foreign ingredients. One method

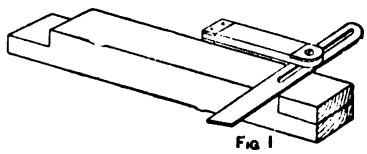


Fig. 1

Setting Out Frame for Wheelbarrow.

commonly employed is to feed the crude material with a current of water into an ordinary log washer; this consists of a horizontal beam from 10 ft. to 25 ft. or more in length, revolving in a horizontal, rectangular, or semi-cylindrical trough of about twice the diameter of the beam. Mounted on the beam are numerous short arms or knives which cut and stir up the lumps, and at the same time carry it slowly to the other end of the trough. The current of water carrying the clay passes from the log washer into a trough or a zigzag series of troughs. The length traversed by the current in the washing troughs and the rate of flow may be varied to suit the character of the material used and the grade of kaolin required. The greater portions of the coarse sand and the larger particles are dropped either in a log washer or close to it, and sand wheels are used to remove this and prevent the troughs from being clogged. The finer sand and the mica flakes are deposited in the zigzag troughs, which are usually about 700 ft. long; they are opened and the deposit is scraped out at intervals. The kaolin carried in suspension by the water flowing through this long zigzag channel is run into larger vats or settling tanks. From these, after a time, the clear water is drawn off and the mud is pumped into a filter press and squeezed by hydraulic pressure. The presses consist of a series of flat iron or wood frames, strung on a central iron pipe. Bags of heavy cloth are placed in the spaces between the frames and connected with the central pipe, which is connected with the pump. The kaolin comes from the filter press in large cakes either round or square, and so that they may dry, these are exposed in racks to the air for several weeks, or put on a floor or in a tunnel and heated by steam or hot air. The cheaper grades of clays are not put through a filter press, being either dried in the settling tanks or transferred to a drying floor directly from the tanks. Another method of washing is to put the clay with water into vessels, where it is thoroughly disintegrated by means of plungers. It is stirred up into a slip which is run off through troughs to settling tanks, made preferably of cypress wood. The kaolin slip is carried thence into the other tanks, whence it is pumped into the filter presses. The clay is removed from the press to the drying floor, heated by exhaust steam. To obtain high grade kaolin, such as that used in making paper, it is usually easy to get rid of grit by elutriation and settling in the washing troughs, vats, etc., iron being avoided by the proper selection of material. The chief trouble is often the presence of almost microscopic plates of mica, which the washing process often fails to eliminate, and which have to be removed by passing the wet material through a very fine silk mesh.

Cleaning a Varnished Map.—To remove dirt from a varnished map, rub the map with a damp cloth or sponge. Most of the dirt can probably be removed by placing the map on a table and rubbing stale bread-crumbs over it with the palms of the hands.

Painting Staircase hung with Wallpaper.—The course to be adopted in painting a staircase hung with wallpaper is as follows. The first thing is to remove the paper with water containing a little soda, and to rub down the walls afterwards with pumice-stone and water. Then fill up with distemper paint, and, when dry, rub down with glasspaper. Give two good coats of size, one hot and thin, the other chilled, to stop suction, make good any defective parts, and again glasspaper down. Coat with colour, nearly all oil and very thin, and follow with successive coats of paint until a satisfactory appearance is gained. Over distemper filling the first coat should be oily; over woodwork it should be flat—that is to say, it should contain a comparatively large quantity of turps.

Setting Out Frame for Wheelbarrow.—This is an easy method of setting out the frame for a wheelbarrow. Make a drawing of the plan of the framing, as shown

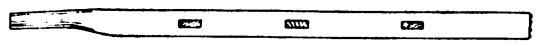


Fig. 2

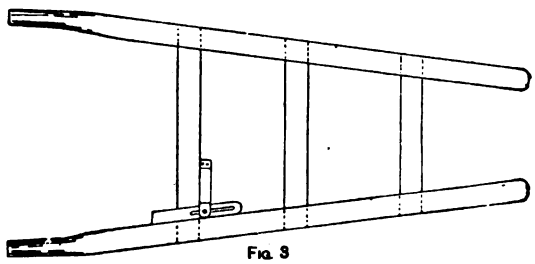


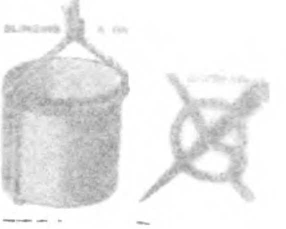
Fig. 3

at Figs. 2 and 3, to a large scale, or full size. Next set a bevel to the angle of the mortises and shoulders as shown at Fig. 3. Then the exact length of cross-bearers or rails can be taken direct from the drawing, and the shoulders can be set out with the bevel as shown at Fig. 1.

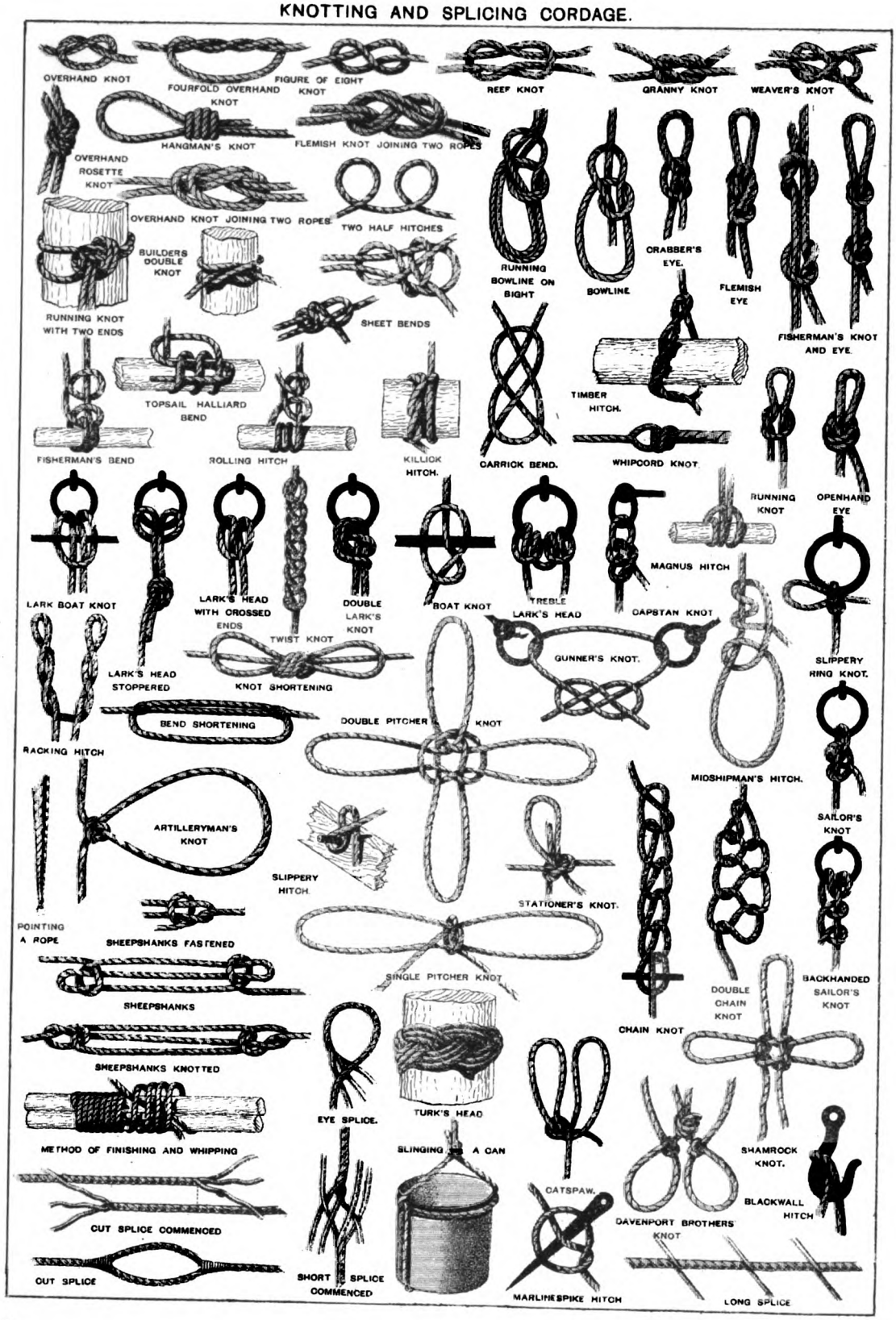
Painting Concrete Surfaces.—For painting concrete, four or five coats of paint should be applied, the first and second coats of white lead well thinned with oil, and the later coats mixed with equal quantities of turpentine and oil. Every coat must be allowed to dry before the next is laid on; on no account should the concrete be painted before it is quite dry.

Measuring Land.—In ascertaining the contents of land, it is usual in measuring on a sloping surface to make allowance for the difference between the sloping length and the true horizontal distance, the latter being the length for buying or selling and for plotting on paper. There are various instruments and tables for giving this allowance, or it may be calculated thus: A fall of 5 ft. vertical in a length of 80 ft. on the slope would give a horizontal distance of $\sqrt{80^2 - 5^2} = 79{\cdot}84$ ft. A fall of 10 ft. in 180 ft. would give a horizontal distance of $\sqrt{180^2 - 10^2} = 179{\cdot}72$ ft. Usually, the measurements are taken with a chain of 66 ft., and an allowance per chain, according to the slope in degrees, is made by pulling the chain forward ½ link, or whatever the requisite allowance may be, beyond the arrow, and then shifting the arrow forward.

Method of using Enamel.—Patent enamels should be used with the same precautions that are adopted in the case of any other enamel. Enamelling should be done in a warm room. Get a clean flat ground on the work, give one coat of enamel, and do not retouch it. If the first coat is not satisfactory, rub off the gloss, or flat it, because enamel should never be put on a glossy ground; then give another coat. Enamelling should not be done when the weather is damp or foggy.


SLINGING A CAN

KNOTTING AND SPLICING CORDAGE.



Polish for Mangle Rollers. — To make a polish for the rollers of mangles and wringers use 1 pt. of methylated spirit, 2 oz. of gum sandarach, 2 oz. of seed lac, 2 oz. of gum benzoin, and 2 oz. of best beeswax. Dissolve the wax by gentle heat in sufficient turpentine to make a thin paste, and add it to the above after the gums are dissolved and carefully strained. Mix well together, and apply with soft flannel or a wadding pad as used by polishers. If the mixture is too thin, or seems a long time in giving a good result, or is to be applied by means of a camel-hair brush instead of pads, add more seed lac.

Design for a Small Porch.—The addition of a porch roof over the door of a workshop or tool house may be made both useful and ornamental. Figs. 1 and 2 illustrate a design in which the porch roof is covered with imitation tiles cut out of oilcloth. This porch roof is suitable for fixing over a door 3 ft. wide. The framework is made of yellow or red pine, 1½ in. square,

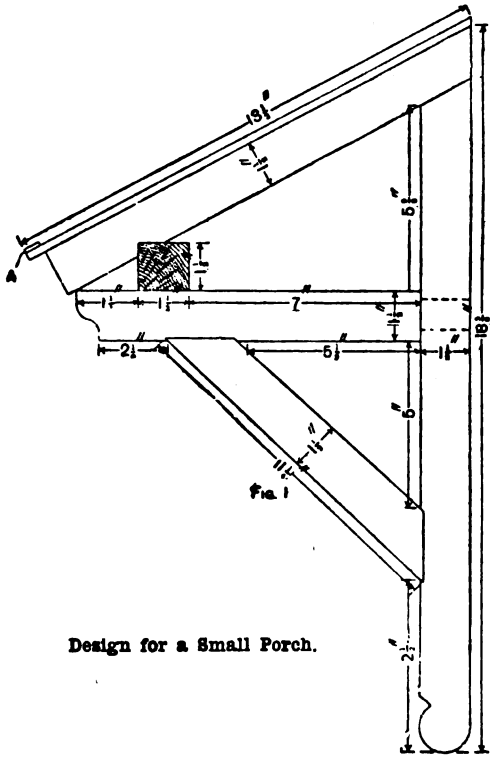


Fig. 1

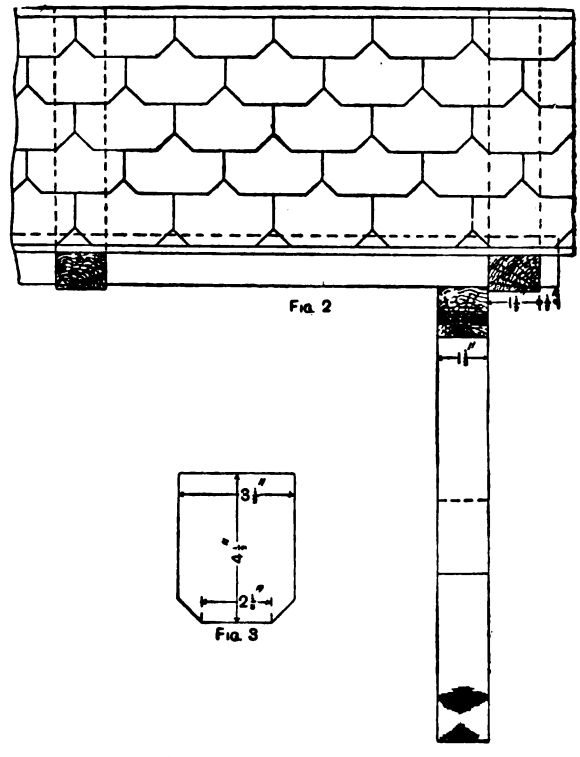


Fig. 2

Fig. 3

Design for a Small Porch.

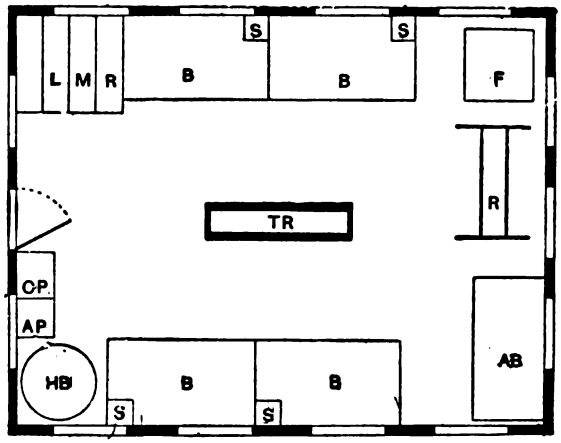
of which 16 ft. will be required; the various lengths being cut off in accordance with the dimensions shown in Figs. 1 and 2. Only one side of the porch is shown in Fig. 1, the other side being exactly uniform. The horizontal piece is mortised into the vertical one, and wedged at the back, all the joints being closed with paint and secured by nails or screws. For cutting out the tiles, obtain some odd pieces of oilcloth of any pattern desired. Cut out of sheet zinc or tin a template of the pattern and size considered suitable, (Fig. 3), and from this template cut the tiles out of the oilcloth, care being taken to discard all pieces having holes in them. When a sufficient number of oilcloth tiles has been prepared—the roof under consideration requires fifty-five—paint them red on both sides, two coats; if only the upper side is painted, the sun and rain will cause them to curl up. Then nail them on to some thin wood, matchboard being preferable, using tinned tacks. Before commencing to nail the tiles down to the boards, a slip of wood ½ in. thick, ½ in. wide, the length of the roof, must be fastened along the bottom edge to form an eaves plate, as shown at A (Fig. 1). Commence nailing the tiles on along the bottom edge, driving a tack in each top corner. The tacks holding the end tiles on each row must not be driven home, as it will be necessary to take these off in order to fasten the roof on to the framework. It is easier to paint the frame of the porch (giving it two coats) before fastening it over the door. After securing the framework in position, by passing nails or screws through the vertical posts, the roof must be placed in situ so as to have an equal overlap at each end, the loose tiles being temporarily removed for this purpose. The top edge of the roof can be neatly finished off by nailing on a strip of wood 1 in. wide, ½ in. thick, bevelled on the front edge, and painted to match the tiles. If the upper edge of the roof is in contact with a brick wall, it is advisable to flash the joint with sheet lead or zinc; but if the eaves of another roof pass over the door this flashing is unnecessary.

Details of Mariner's Compass. — The compass bowl is suspended in gimbals in order to allow it to retain its horizontal position independently of the ship's motion. From the centre of the bottom of the bowl is a vertical steel-pointed pillar; the compass needle is fitted with a brass cap, in which is fixed an agate bearing that rests on the steel point. The compass card is divided on its edges into degrees, the degree circle occupying about ½ in. of the card edge; the next circle contains the numerals of degrees marked from 0 at the north and south points to 90° at east and west. Thus the reading in degrees at sea is taken from the south point for the southern semicircle—*e.g.* what a surveyor reads as 120° the helmsman reads S.60°E. The points, thirty-two in number, are as follows. North, N. by E., N.N.E., N.E. by N., N.E., N.E. by E., E.N.E., E. by N.; East, E. by S., E.S.E., S.E. by E., S.E., S.E. by S., S.S.E., S. by E.; South, S. by W., S.S.W., S.W. by S., S.W., S.W. by W., W.S.W., W. by S.; West, W. by N., W.N.W., N.W. by W., N.W., N.W. by N., N.N.W., N. by W. These letters are printed radially towards their respective positions at 11¼° apart, which equals 1 point—that is, 360° ÷ 32. The central portion of the card is decorated with a star to help in distinguishing the points at a glance. The card is cemented to the needle and adjusted to hang horizontally by dropping sealing-wax on the under side where required; the glass lid screws on to the bowl, which is of copper.

Reducing Paper to Pulp.—Boil the paper with a solution of caustic soda, using some sort of stirring or beating arrangement to break up the felted fibres. It should then be turned into a tank and washed with water until free from alkali. If a flexible material is desired, add some soap to the pulp and boil, then add alum solution until the soapy feel has been destroyed; this will produce an alumina soap which will bind the fibres.

Chrome Tanning. — A chrome tanning bath is made, according to an American patented process, in this manner. Twelve pounds of chromic acid are dissolved in 6 gal. of hydrochloric acid of a specific gravity of 1·146; 50 lb. of chrome alum are dissolved in about 20 gal. of water; thirdly, 75 lb. of washing soda are dissolved in about 10 gal. of water. The soda solution is now slowly poured into the chrome alum solution until the result appears cloudy and a sparkling silver mist is seen on the surface, when water is added to make up the liquid to 44 gal. The solution is now run into the chromic acid solution and the whole allowed to settle. A 1½ per cent. solution of this liquid is used for the chrome bath (*i.e.* 1½ gal. of the liquid to 98½ gal. of water) for tanning, and the hides are hung in this. As the tanning proceeds, the strength of the bath is made up by more liquor to 4 or 5 per cent., and the temperature of the bath is kept at 80° F. When the thickest parts of the skins show a bluish-green colour, the tanning has proceeded far enough; the hides are then washed in water containing 1 oz. of borax in 20 gal. The time of tanning is for sheep-skins about one hour; goat-skins about one and a half hours; calf-skins two to four hours; and heavier materials ten hours.

Arrangement of Tinmen's Workshop.—A workshop of convenient size for four tinmen is shown by the accompanying diagram. The benches B, made of beech-wood, should be firmly built, and secured to the floor by iron brackets. Racks for small tools could be placed on the wall at the back of each bench, and the pipes from the stoves S carried to the chimney over the forge F.



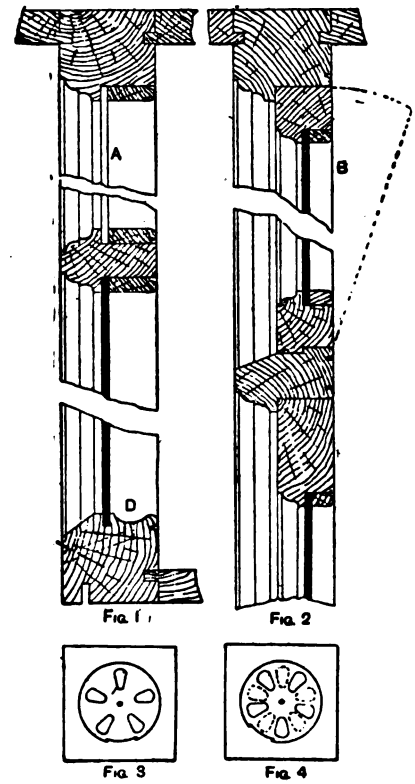
Plan of Tinmen's Workshop.

Hooks for carrying bundles of wire might be placed on the wall behind the rollers. The larger sheets of metal could be stood on their long ends in the racks L, M, and R, and the smaller plates in boxes on the top of the racks. The letter references not already mentioned are as follow: A B, angle bender; A P, ash pan; C P, coke pan; H B, hollowing block; R, rollers; and T R, tool rack.

Paint for Mirror Back.—The silvered back of a mirror may be protected by applying two coats of a mixture of ¼ lb. of red lead ground fine, 2 oz. of paper varnish, and 4 oz. of turpentine. Allow twenty-four hours to elapse before applying the second coat.

Dyeing Feathers.—Feathers are now dyed almost entirely with coal tar or aniline colours, these being very brilliant. Although most of them fade, some stand exposure to light extremely well. Previous to dyeing, all feathers should be soaked in a hot bath containing a moderate quantity of Castile soap, followed by a second bath of washing soda or carbonate of ammonia; these remove all grease and soften the feathers so that the dyes penetrate better. It is difficult to advise with regard to colours; experiment with the recipes that are given below. Cardinal: Boil 1 lb. of ground cochineal in 1 gal. of water, filter, and, while hot, steep the feathers for one hour; remove, add to the bath 2½ fl. oz. of tin solution, replace the feathers, and keep the bath hot for several hours. To prepare the tin solution, dissolve 8 oz. of tin in 6 oz. of hydrochloric acid and 3 oz. of nitric acid. For indigo, boil for half an hour in a bath containing 4 oz. alum, 2 oz. argol, and 1½ oz. extract of indigo; run off half the bath, add infusion of 6 oz. to 9 oz. logwood chips previously made, and re-dye at a lower temperature (122° F.). Madder might be tried alone; it is, however, used principally in cotton dyeing, and the operation is a very complicated one. For saffron, use a tin mordant followed by an infusion of saffron. The latter substance is much too expensive to use for commercial dyeing. Turmeric in powder must be dissolved in methylated spirit, and the solution filtered; the feathers are then dipped in, removed, and dried.

Preventing Steam Condensing on Shop Windows.—The chief cause of steam condensing on shop windows is insufficient ventilation. In constructing shop fronts provision should always be made for an iron ventilating grating at the top of the sash as at A (Fig. 1); also for a fanlight over the door as at B (Fig. 2). The grating may be fitted with a hinged flap on the inside so that it can be closed when not required; the fanlight is hinged to the transom to fall inside on quadrants, or is fitted with gearing. The sill of the sash is prepared for the



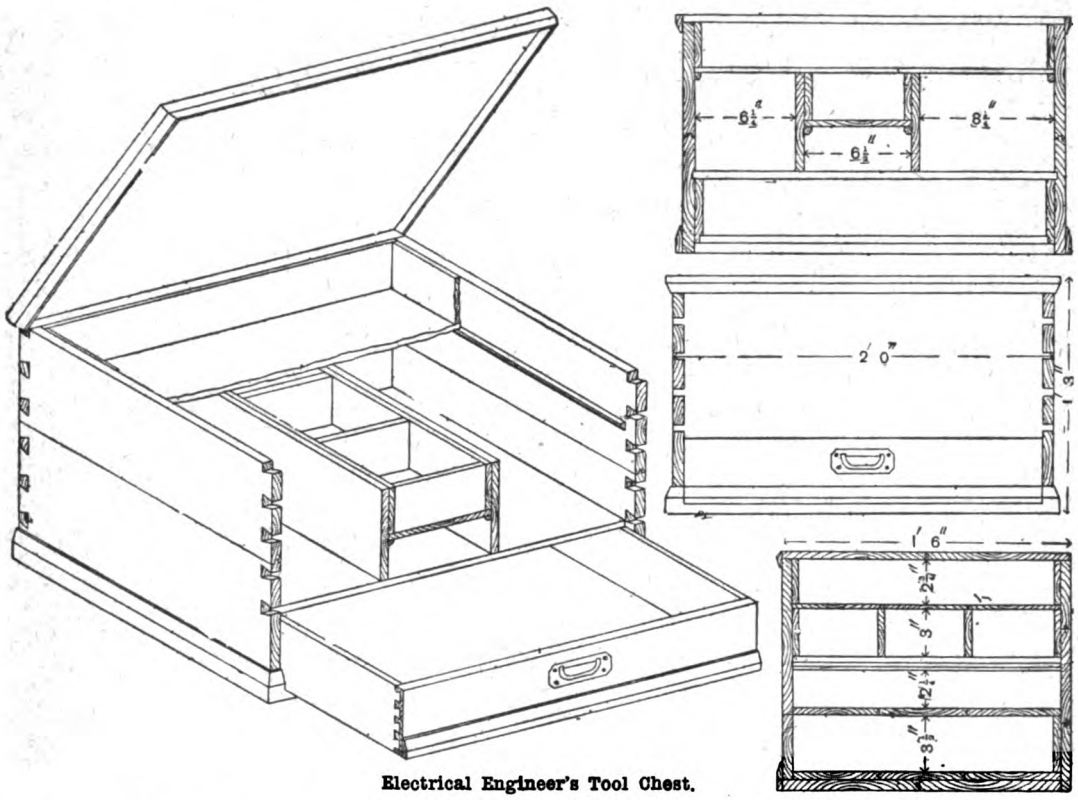
Preventing Steam Condensing on Shop Windows.

escape of condensed moisture (see D, Fig. 1); the bead which fixes the glass will intersect with the bead on the sill in the hollow, and from the outside a hole is bored and a zinc tube about ¼ in. diameter is inserted (see dotted lines); this will carry away any water that may collect and prevent it running on to the show-board. Figs. 3 and 4 show, open and closed respectively, a glass louvre ventilator for fixing on to the plate-glass in the sash; these ventilators may be effectually used when there is no ventilator at the top of the sash.

Staining Tonquin Canes.—The hard, crusty surface of canes renders them practically impervious to water stains. A brown tone may be gained by scorching the canes in a gas flame—a gas-stove flame for preference. Bamboo workers generally colour up the articles after they are made. This is done by mixing suitable pigments, as vandyke brown, brown umber, or black, with French polish or spirit varnish thinned out with methylated spirit, a coat of clear varnish being applied afterwards for finish. If the canes have been stored in a damp place to render them soft, try a stain made by mixing vandyke brown with American potash and hot water.

Rendering Wood Fireproof.—There have been a great number of compounds or mixtures proposed for fireproofing wood, fabrics, and other inflammable materials. Among the best of these may be mentioned ammonium chloride, ammonium phosphate, ammonium sulphate, alum, borax, boric acid, calcium chloride, magnesium chloride, sodium silicate, sodium tungstate, stannous chloride, and aluminium hydroxide. Any of these may be applied in solutions of 5 to 10 per cent. strength, except the last; aluminium hydroxide is formed as an insoluble substance in the fibre by soaking first in aluminium sulphate solution and afterwards in ammonia. Alum is very often used, and by some sodium tungstate is considered the best preventive of fire. A good mixture is ammonium chloride 15 parts, boric acid 6 parts, borax 3 parts, and water 100 parts, heated to boiling, and the wood or fibre plunged into it.

Electrical Engineer's Tool Chest.—The accompanying drawings show the construction of a suitable tool chest for an electrical engineer. The sides, lid, and bottom should be made of wood about ¾ in. thick when



Electrical Engineer's Tool Chest.

finished; the trays can be of thinner wood, about ½ in. or ⅝ in. finished size. In the isometric view, part of the top tray is shown cut away, and also the front of the box, so as to show more clearly the construction of the interior.

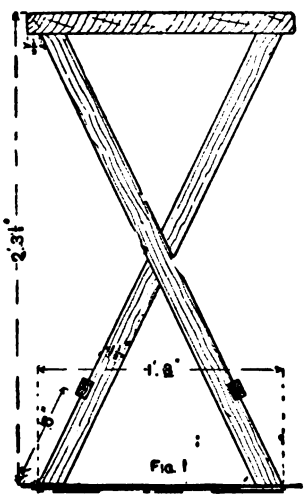
Clock Striking too Quickly.—To prevent the striking train of a clock running too fast, it is controlled by a "fly," which is a small fan fixed to the last pinion of the train. The fly should be sufficiently tight to turn when the pinion turns. If it is loose, the pinion is liable to run round quickly while the fly stands still and allow the clock to strike too rapidly. Therefore, see that the fly is tight upon its pinion. If it is, and the clock still strikes too fast, try extending the surface of the fly as much as possible by gumming paper to its edges.

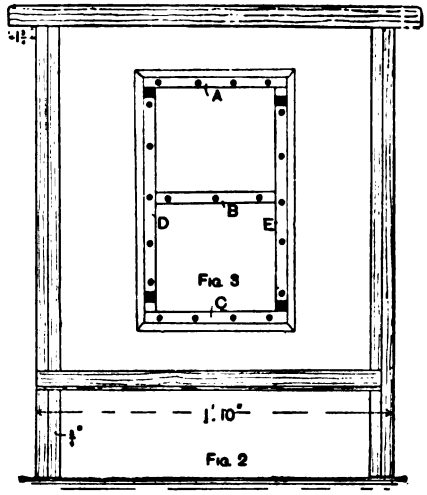
Mixing and Preparing Mortars.—Often a wall has its strength estimated by the amount of power necessary to crush the bricks, instead of by the forces or influences that will render the mortar unfit for its purpose. The mortar should be made from the very best materials that can be obtained, as practically the strength of the mortar determines the strength of a brick structure. The lime should always be freshly burnt, as stale lime loses the power of setting firmly. For the very best lime mortar, hydraulic lime should be used, stone or grey lime being used in cheaper mortars. Hydraulic limes should be finely ground, otherwise they are liable to slake when they have been built in the work, and the swelling which ensues will crack and spoil the wall in which they have been used. Also hydraulic lime mortars must be used immediately they are made, as they set rapidly as compared with the stone or grey lime mortars. Chalk lime should never be used for building purposes, except in small sheds where cost prohibits the employment of a better lime. Chalk limes must not be used in making mortar for dwelling-houses. All limes before being mixed with sand should be thoroughly slaked. This is generally done by measuring out the required quantities of lime and sand, and forming with the sand a ring in which the lime is placed, water being added in sufficient quantities to slake the lime, and care being taken not to add more than is necessary. The slaking commences by the lime absorbing the water, and the swelling of its bulk, accompanied by hissing and giving off of steam; the purer the lime the more violent is the slaking process; hydraulic limes sometimes take hours to commence, while chalk limes start immediately. The sand is shovelled over the slaking lime, and the whole mass is left for a sufficient time, after which the lime and sand are thoroughly incorporated, making the required mortar. The sand used must be free from all earthy material, pit sand being considered the best; if the sand does contain organic or clayey matter, it should be washed before use. The proportion of sand and lime used in forming mortar are stated on p. 89.

Recipe for Branding Ink.—To make a branding ink, saturate water with 1 oz. of either gum tragacanth or gum arabic. Work up bone black into a stiff paste with the gum solution, and incorporate with a small quantity of soluble Prussian blue or indigo; add a few drops of creosote, and press into boxes. Glycerine may be used in place of the gum solution, and makes a very nice ink, but it does not dry very quickly. Another method is thoroughly to work up equal parts of soluble Prussian blue and lampblack or bone black with a little glycerine. Then make it into a paste of suitable stiffness with solution of gum arabic.

Making Upholsterers' Pom-poms.—One way of making the pom-poms used by upholsterers is to lap a wood or cardboard washer with three or four thicknesses of fibres, which may be of silk, worsted, or cotton. Cut all the fibres at the outer edge of the ring with a pair of pointed scissors; this will release the ring. Bind the tuft in the centre with fine silk twist, and trim the pom-poms to shape. Another method is to knock two smooth spikes into a board, say 1 ft. apart, wrap the materials round the spikes to the required thickness, and tie up every 1½ in. Cut off in the centre of each tie, which will make eight pom-poms. Flatten with a blow from a mallet or by pressure. For fine work a rough creel could be fitted, and ten to twenty of the strands wrapped at once. A vandyked edge could be given to the pom-poms by trimming with a mattress tuft punch.

Light Table for Bedroom.—Figs. 1 and 2 are end and front views respectively of a light table that might stand by the bedside for the convenience of an invalid. For the ends, procure four pieces of wood each 2ft. 6in. long, and planed to 1½ in. by ¾ in. These are fixed permanently together in pairs with screws (not shown). Only two connecting bars are required, these being 1 ft. 9½ in. long, planed to 1 in. by ¾ in. Fix these to the ends as in Fig. 1. For the foundation of the top obtain a board about 2 ft. long, 1 ft. 3 in. wide, and ½ in. thick, either in one piece or by glueing two pieces together. This may be covered with oilcloth of the chequered Indian matting pattern, which is easily washed, and which may be fixed down with thin glue. Fig. 3 shows how the bars on the under side are arranged. They are all of 1-in. by ¾-in. material. First glue and screw on those marked A, B, and C (Fig. 3), and then by long screws fix those marked D and E to the tops of the pieces forming the ends, shown by black rectangular patches. Now place the top in position and glue securely to the bars D and E, and screw from the under side. Run a piece of stop bead 1½ in. by ¾ in. round the top and mitre it at the corners. This gives a good finish and prevents anything sliding off the table. Two coats of blue enamel paint may be given to the article; or, if made in hardwood, it might be polished.





Light Table for Bedroom.

Stump Moulding.—The term stump moulding is generally applied to ironfounding, in which parts of cast-iron are added to other castings or to wrought-iron work, as in bedstead work, where the cast-iron knuckles are cast on the angle-iron forming the side-stays. This operation is done in the same way as ordinary founding, by placing the part to be inserted in the finished mould and pouring the metal on it. In brassfounding the term denotes the method used in cock-founding known as plate casting. In this method the patterns are specially made and fixed on a metal plate in a frame, which is reversible. Instead of the moulding tub, use brackets on the wall or other stand in the shop. The mould is made to one side first by applying the peg-side and making the mould in the ordinary manner. The peg-side is removed, the plate frame is reversed, a hole-side is put on, and the other half of the mould is made. This method obviates making an odd-side. Probably an iron moulding machine, similar to those used in wheel moulding, etc., would be an assistance, as the moulds could be more quickly made by using machine pressure. If using the above-named machine, the pattern plate, which serves as the parting plate, has half the pattern projecting from each side, as previously stated. The mould is formed in sand contained in two moulding boxes which are placed on the pattern plate, one over and one under. The sand is pressed within the moulding boxes by the action of rams, which serve also, upon the removal of the pattern plate, to eject the sand moulds from the boxes. The advantage of the machine is that moulds may be made in one-eighth the time used in hand moulding.

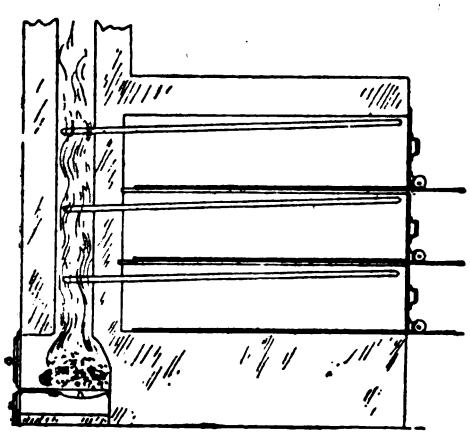
Preserving Clay Figures.—If the clay figures have been painted with ordinary oil paint it would be impossible to fire them, for the heat would immediately burn away the colours. Besides, the heat of an ordinary oven would have little effect on the clay except to dry it. To preserve modelled objects without casting, model them in plaster-of-Paris. A little glue added to the water when gauging the plaster will prevent it setting, with the result that the plaster may be handled like clay. Cream of tartar will also retard the setting properties of plaster. When quite hard, the modelled figure may be dipped in melted paraffin wax, so that it becomes susceptible of a high polish, and by the addition of certain pigments to the wax a colour may be imparted to the figure. For instance, a little yellow ochre will give the appearance of old ivory. Drapery may be represented by dipping strips of cloth in the plaster and arranging them on the figure. To judge the amount of size water to be used when gauging the plaster, dissolve some good glue in water and measure a certain quantity of this with a certain quantity of water. With the mixture gauge a small quantity of plaster to discover how long the mixture takes to set. Small clay models, if varnished, may be preserved for an indefinite time, but, being simply dry clay and not having been burnt, they are easily broken.

Colouring Gold Articles.—Gold alloys of not less quality than 15 carat may be made to assume the colour of fine gold by carefully boiling them in a mixture of nitrate of potash 15 oz., table salt 7 oz., alum 7 oz., and spirit of salts 1 oz. The work must be previously annealed and boiled out in aqua-fortis pickle, and wired with platinum wire. It must only be exposed to the colouring mixture for five minutes at a time, and well rinsed in boiling water between each operation. If 18-carat gold alloys are employed, the colouring mixture may consist of 1 oz. more of each of the above ingredients, omitting entirely the spirit of salts, and making the other powders into a paste with hot water. In all cases it is advisable to thin the colouring mixture with hot water as the process of colouring progresses, so as to avoid overdoing the work.

Making Red Stencil Ink.—Below are instructions on making a red stencil ink for marking boxes, etc. Get 3 lb. of pure pipeclay (not a mixture of pipeclay and whiting), and crush or scrape into a fine powder. Make a stiff mixture of Indian red in water, scrape a few shreds of soap into the Indian red, and mix well. Now gradually add the pipeclay until the mixture is of the consistency of putty. Then make it into cakes, and dry with gentle heat for use.

Determining Diameter and Pitch of Rivets.—For single riveting up to 1-in. plates the diameter of the rivet may equal one and one-fifth times the square root of the thickness of the plate, the rivet hole being one-twelfth larger. The pitch may equal 1·09 in. plus the diameter of the rivet hole. For a ½-in. plate the rivet by this rule would be 1⅛ in. in diameter and the pitch about 2¼ in.

Baker's Steam-heated Oven.—The accompanying sketch shows the principle of improved decker ovens, heated by steam, for baking bread. It should not be taken as a working drawing, as the erection of such ovens must not be undertaken without previous experience, or working to a maker's particulars. The ovens are heated by a row of tubes running from back to front, the back ends starting from the furnace flue as shown, whence they slope upwards. The tubes are each separate and have their ends welded up, but previous to being closed they are about one-fifth filled

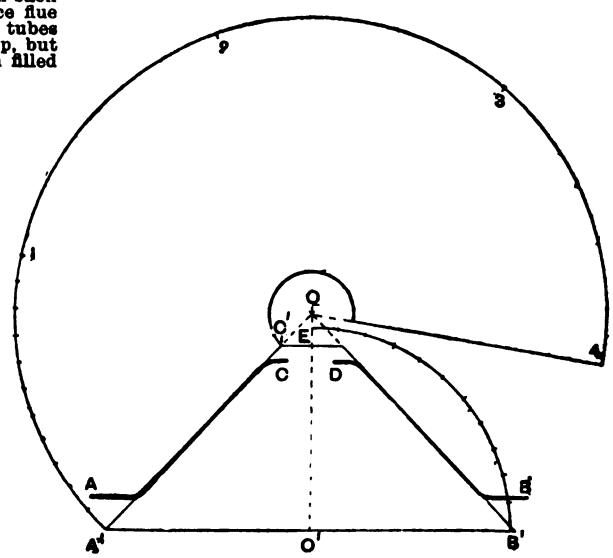


Baker's Steam-heated Oven.

with water. The sloping position of the tubes causes the water to come where the heat is felt, with the result that the tubes get quickly filled with high-temperature steam. It will be noticed that the furnace comes at the rear of what may be considered the front of the ovens, and all stoking is done away from where the preparation and baking are done.

Chinese Lacquer Work.—The red gold and pale yellow effects seen on Chinese lacquered cabinets, etc., are produced by the aid of lead, tin, or silver foil laid upon a smooth surface, and coated with various gum varnishes. Very effective panels may be made upon this principle, and these may be utilised in the construction of screens, cabinets, etc. When sheet metal is used it should be perfectly free from marks of any kind, and should be highly polished. If wood is employed it must be planed very flat and then smoothed with fine glasspaper, being afterwards sized and primed with two coats of white lead and yellow ochre mixed with drying oil and a little oil size; rub down each coat with pumice powder and water. Next coat with flat black and rub down, first with finest sandpaper, then with a dry cloth, and finally with the palm of the hand, taking great care that particles of dust do not remain. Now give an even coat of a mixture of 2 parts of black japan and 1 part of gold size, and after rubbing down, when dry, with pumice powder and water the panel is ready for the silver leaf. The portions to be treated with foil are then coated with gold size to which has been added a small proportion of linseed oil, and when these parts are of the proper "tackiness" the leaf or foil is laid on, as in gilding. When dry and the surplus metal removed, the subjects are toned, shaded, and tinted: for the darker shades, dragon's blood mixed with turpentine is used; gamboge forms the lighter shades. All the transparent oil-colours, as used by artists, may also be used for various effects upon the foil. In say a landscape, the figures, sun, and water may be covered with foil, whilst the other portions of the landscape may be executed in oils, and should be suggestive rather than detailed. When dry, wash with water containing a very little soda, and finish by varnishing.

Making Wrought-iron Cone.—Below is explained how to make from ½-in. thick plates a wrought-iron cone of a rather pronounced slant. The lath being so great, the flange may be thrown off, and the seating at the small end of the cone worked in after the cone has been bent to shape and the seams made. To cut the pattern for a cone made in this manner, first draw an elevation of a section through the centre as A B C D. Produce the sides of the cone, and make the length to A′ B′ equal to the length necessary for the flange, and also make the length to O′ equal to the length to be worked in to form the seating. Where the lines produced intersect at O is the apex of the cone. Use this as centre, and with the radius O A′ draw an arc of a circle. Now divide the quarter circle O′ B′ E (using O′ B′ as radius) into any convenient number of equal parts, and set off a corresponding number of similar divisions on the curve of the pattern, as A′ 1. Now take the distance A′ 1



Pattern for Wrought-iron Cone.

and set off from 1 to give the point 2; if a line were drawn from 2 to the centre O this would give one-half of the pattern. If it is found convenient to cut the pattern in one piece, set off two other divisions as 3, 4. Join 4 to the centre O, and then with O as centre and O C′ as radius, describe the arc of a circle shown to form the small end of the cone. The cone could be partly bent to shape in the rollers, and then worked round true upon a mandrel. Braze the seams, and then throw off the flange with a stretching hammer, working it to an arc of a circle first upon the mandrel, and then working it down flat afterwards upon the flat end of the anvil. The small end could be set in by working overhand upon an upright circular stake with the edge bevelled off. First tuck the metal in round the edge with cross blows from the stretching hammer, then set it in on the shoulder of the head a short distance down from the part first tucked in. Now work from this furrow up to the top edge, beating the metal over while working upwards to form the shape required. Again tuck the metal in at the top, and repeat the process described above until the work is brought to the desired shape.

Re-blackening Thermometer Scales.—The best way of re-blackening the impressed figures and divisions of thermometer scales on boxwood is to use a drawing pen filled with japan black; this would of course be a rather tedious operation. Another method, but not so good, is to paint the boxwood scale all over with japan black, making sure that it enters all the lines and figures; then roll up a piece of smooth cloth into a ball, damp it with turpentine, and with this remove from the boxwood all the japan black with the exception of that in the depressions. This should not be difficult if the rubber is used gently and the impressions are deep.

How to Clean Engravings.—The following method of cleaning engravings has been found effective whenever dirt and faint stains were to be removed, though probably it is not so efficient as the chloride of lime process (described on p. 206) in dealing with stains of long standing. The specimen to be cleaned should, if possible, first be detached from its mount. Lay it face upwards on a clean, smooth board in the sink, or similar place, and sprinkle it with ordinary salt till thinly covered. Then take a lemon, cut it, and squeeze the juice over the engraving so as to dissolve the greater proportion of the salt. Then raise one end of the board to slant at an angle of about 25°, and flood it with nearly boiling water until all the salt and lemon juice are washed away. Drying must be allowed to proceed spontaneously.

Transferring Design to a Saucer.—If it is wished merely to fit the design to the concave face of the saucer, to be painted over by hand afterwards, fold up the drawing which it is desired to transfer as shown at Fig. 1 in such a manner as to fit the curved surface,

Transferring Design to a Saucer.

FIG. 3.

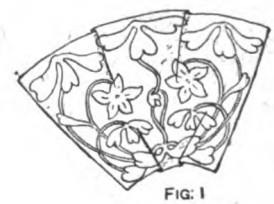


FIG. 1

FIG. 4

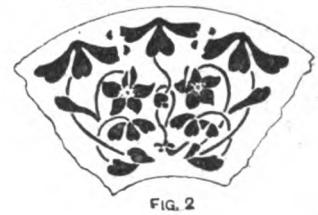


FIG. 2

and adapt the drawing to these folds. Fig. 2 shows the drawing arranged to suit the folds. Manufacturers, however, adopt a different method. Fig. 3 shows the pattern repeated three times round the circle. It will be noticed that the design does not entirely fill the circle, but that a small blank space has been left. In the necessary folding of the drawing to fit a circular concave surface the diameter of the circle on which the design is drawn must be considerably larger than that of the saucer—that is to say, in a saucer of 6-in. diameter, it will be necessary to draw the design on, say, a 7¼-in. circle. The spaces marked + + + in Fig. 3 are left vacant, so that there may be as little distortion as possible when transferring the printed pattern on to the saucer. Fig. 4 shows the appearance of the paper containing the design when stuck on the saucer. The following is the process employed in producing these designs. When a design has been drawn, the engraver cuts it out on a copper plate, making the incisions deeper where a darker shade is required. On to this engraved plate paint is rubbed to fill the lines, all superfluous colour being carefully cleaned off. A sheet of thin tissue paper is laid over the plate and pressed into it by means of an iron roller covered by three or four wrappings of felt. The print is then cut out with scissors, laid round the saucer, and worked into place with a dabber made of rolled flannel. The transfer is left on the saucer, which is in the "biscuit," or half-fired, state, for half an hour or so, when the paper is washed off, leaving the design on the saucer. In the colours composing the design there is a certain amount of oil, which stains the biscuit ware; this oil has to be burned off before the glaze is applied. This is done by placing the ware in a heated kiln. When the oily matter has been expelled, the saucer is dipped into the liquid glaze, which is a solution of borax glass containing lead salts and silica. The saucer will be dry in about five minutes, when it looks as if it had been whitewashed, the design being completely obliterated. The saucer is now put in an earthenware sagger, or crucible, and heated to a white heat for sixteen hours in the kiln, during which period the glaze has fused and turned into a transparent glass through which the design is visible. The saucer is now finished.

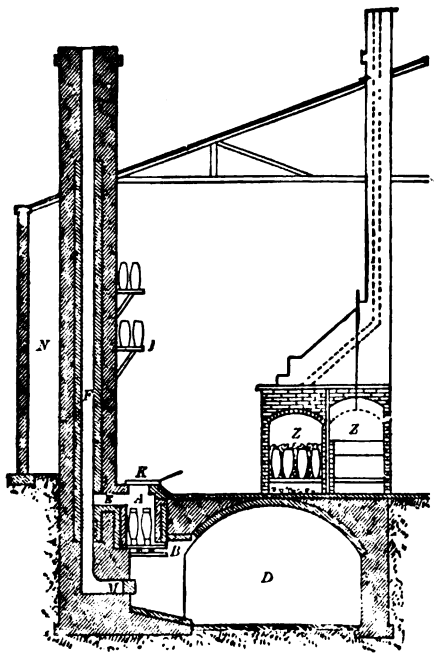
Polishing Ebony Mirror Frame.—Unless the ebony is of a particularly good quality there will be a brown or greenish tinge that should be overcome by wiping the frame with a good quality ebony stain, which can be bought ready made. The frame may then be finished by polishing with white or transparent polish. Or a combined ebony stain and polish may be used. This is made by mixing with the polish sufficient gas black or Frankfort black to gain the tone desired. An aniline spirit dye is used in most good shops, for the reason that it does not thicken the polish. In any case the best results are gained if the black is used thinly in the preliminary stages, and the final bodying up and finishing out are done with transparent polish. As ebony is a close-grained wood, no grain filler is required, and only a small quantity of polish. To apply the polish use wadding pads, slightly moistened with linseed oil.

Removing Varnish from Oak Carving.—To remove varnish from an oak carving a solution made as follows is used. Put equal parts of turpentine and methylated spirit into a stone jar and place the latter in a saucepan partly filled with water—glue-pot fashion. Put this in an oven and bring up to blood heat; then brush the solution over the carvings. As the varnish softens take it off with a nail brush. When all the varnish has been removed, apply several applications of oxalic acid—2oz. to 1 pt. of water. Swill off with plenty of clean water, and finally brush over with common malt vinegar to kill any trace of acid.

Paint for Leather Trunks.—To paint leather black, first coat it with a solution of alum 1 oz., and water 1 pt. The next coat should consist of drop black ¼ lb., ground in turps, and terebine ½ oz. Thin with turps. When this is dry give a final coat of drop black and Coburg varnish, mixed to the consistency of cream. For white paint use zinc white instead of black, and sugar of lead, ground fine, instead of terebine.

How to Fix Marqueterie Transfers.—Marqueterie transfers as used by French polishers for decorating furniture are fixed as described below. The design, with a fair margin of paper around it, is cut from the sheet, and is laid, face upwards, on a sheet of newspaper. A thin, even coat of good quality spirit varnish is then applied with a camel-hair brush and allowed to stand for a few seconds till the varnish becomes sticky. The design is then laid in the desired position, face downwards, and pressed well down so that all parts thoroughly adhere. After an interval of five minutes the back of the paper is damped with warm water and pressed down again. The paper is then saturated with water and allowed to stand for a few minutes, after which the paper should glide off, all surplus moisture being taken up with a clean moist washleather. The work is then set aside in a warm place. The best results are gained if the design is fixed after the work is merely bodied up. The subsequent bodying up and finishing will enable a fair body of polish to be applied, thus gaining solidity and appearance of inlay. To ensure accurate fixing of the design, tally marks should be made at its chief points, corresponding marks being made on the article to be decorated.

Crucible Steel Furnace.—The sketch herewith gives a sectional view of a crucible steel furnace. The melting chamber A should be 3 ft. high from the grate bars B, oval in shape, 26 in. by 19 in., and lined with 6-in.



Crucible Steel Furnace.

ganister. The flue E leads from the melting chamber A into the chimney stack F. The cold-air flue M leading from the cellar D is used to regulate the draught. The chimney stack F, lined with firebrick, should be from 35 ft. to 40 ft. high. K is the cover of the melting chamber; I the shelves for drying crucibles; N the chamber behind the stack for drying crucibles, storing charcoal, etc.; and Z, Z the annealing ovens.

Recipe for Saddle Soap.—To make saddle soap, gently heat over a slow fire, constantly triturating till thoroughly incorporated, 1 lb. of beeswax, 8 oz. of soft soap, 2 oz. of linseed oil, and ½ pint of oil of turpentine; put in pots or tins. Rub a very little well into the saddle and polish with a soft brush.

Small-power Water Motor. — The motor shown in plan by Fig. 1 and in elevation by Fig. 2 will develop ¼ brake-horse-power with a fall of 30 ft. through a 2-in. pipe, and ½ brake-horse-power with a fall of 50 ft., the speeds being about 3,000 and 5,000 revolutions per minute. To make the wheel, get a brass casting A (Fig. 1) to be turned to 2½ in. diam. by ½ in. wide. Fix centres in the disc and scribe a guide circle 1⅞ in. in diameter; mark off twelve equal parts on the edge, and from these draw tangents to the guide circle. With a sharp chisel mark in the lines to about ⅛ in. back from the rim, and mark lines across the rim joining the marking on both sides. Saw these lines in about ⅛ in. with a sharp hack-saw, for receiving the cups. From ⅛-in. sheet brass stamp the cups with the punch (Fig. 3) and trim off with shears. Then place the cups in position, tin the joints with a soldering bolt, and place the cup disc on a fire to sweat. Castings for the bearings should be turned to dimensions (see Fig. 1),

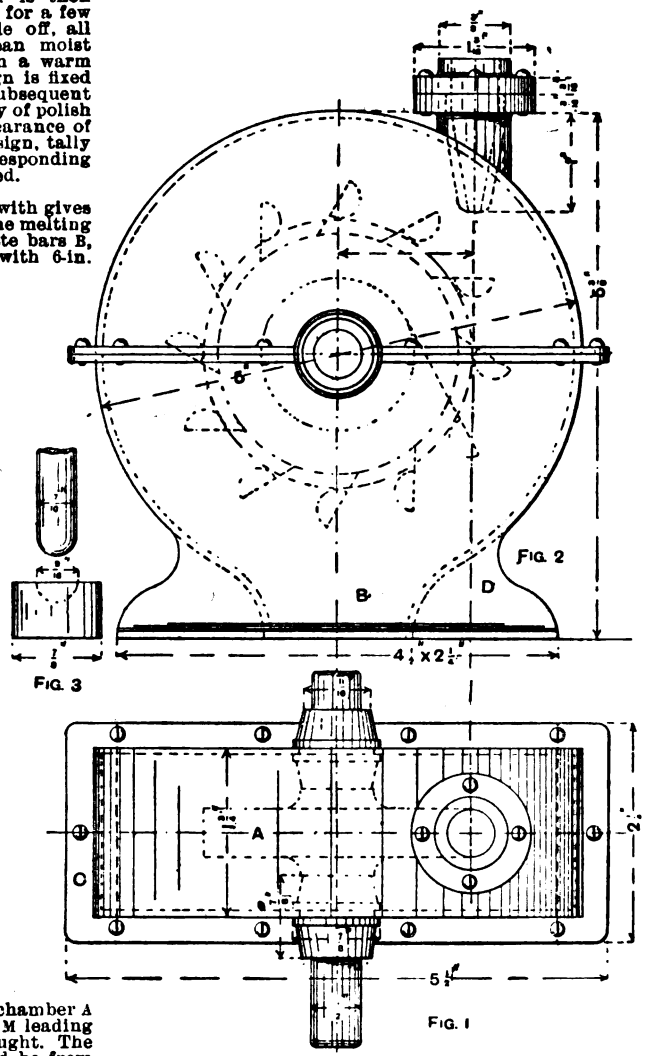


FIG. 2

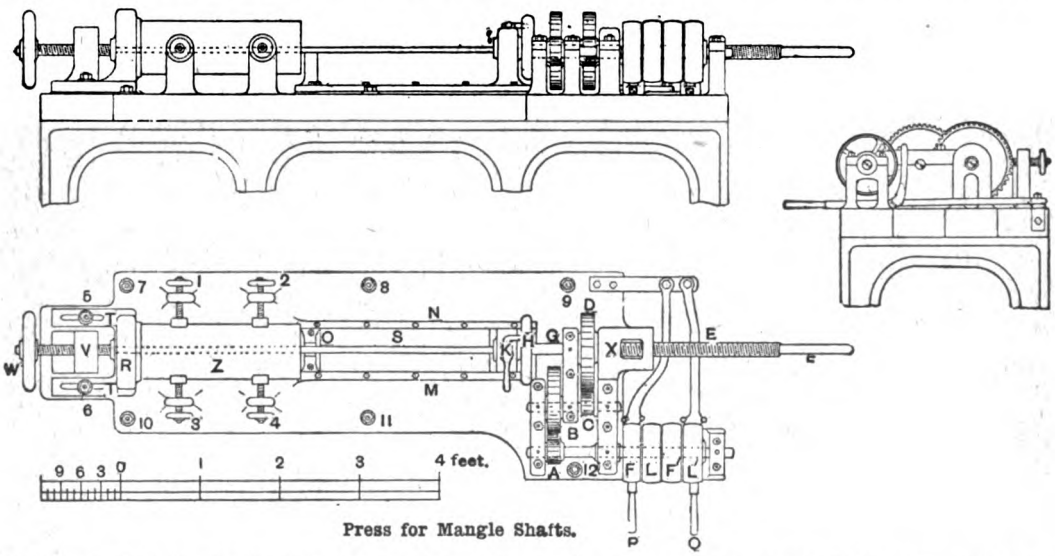
FIG. 3

FIG. 1

Small-power Water Motor

making the groove in the centre an exact fit for the ⅛-in. sheet metal, of which the casing is constructed. Obtain a casting for the gland to which the nozzle is fitted, and turn this inside an exact fit for the nozzle. From ⅛-in. sheet iron cut out and bore the two flanges C (Fig. 1). The lower half of the casing is worked from ⅛-in. sheet iron (blued). First cut out two pieces to shape B (Fig. 2). At each top edge file out a central semicircle exactly the diameter for the bushes. From the same metal cut two strips 1⅝ in. broad and 6 in. long, and bend them to shape D (Fig. 2). Fix the whole of these parts by twisting thin wire round them and solder all together. The top cover is next made in the same way. The nozzle gland is then carefully fitted and soldered or brazed on. As a caution, do not make the nozzle of a high-speed motor more than ⅛-in. bore at the opening, but make it larger for a slower speed.

Press for Mangle Shafts.—The accompanying drawings show, with scale, a machine for pressing shafts in mangle rollers to be driven by steam. Two belts, one open and the other crossed, drive the pulleys F, L, F', and L', and by means of the striking gears P and Q the pinion A can be made to revolve in either direction, or the straps can be moved to the loose pulleys. As will be seen, the pinion drives the tooth wheel B, and the latter, being keyed on the same shaft as the pinion C, the tooth wheel D is driven in either direction as required. D has a thread cut in its boss and works the screw E, causing it to move backwards or forwards through the thrust block X. The plain parts of the screw shaft at F and G are for the purpose of preventing accident in the event of the striking gear not being moved quickly enough. Thus, when the tooth wheel D gets on the plain parts it will simply revolve without causing any movement of the screw; then the screw can be turned into the thread of D by the hand wheel H. It will only be at such times as these that the screw shaft will revolve, as the hand wheel H will be locked to the driving head K as indicated. The driving head K works between the planed sides M and N. The fixed head at O is simply for holding the mangle shaft S in position and for adjusting the mangle roller Z; this latter is held in position by means of the four cramps 1, 2, 3, and 4 as shown. The



Press for Mangle Shafts.

backthrust block R, with its slides T, T, can be moved backwards or forwards by means of the hand wheel W and screw working through the block V, and when adjusted can be firmly held to the bed by the two bolts and nuts shown at 5 and 6. The bed should be bolted to iron supports or other suitable foundation by bolts and nuts shown at 7, 8, 9, 10, 11, and 12.

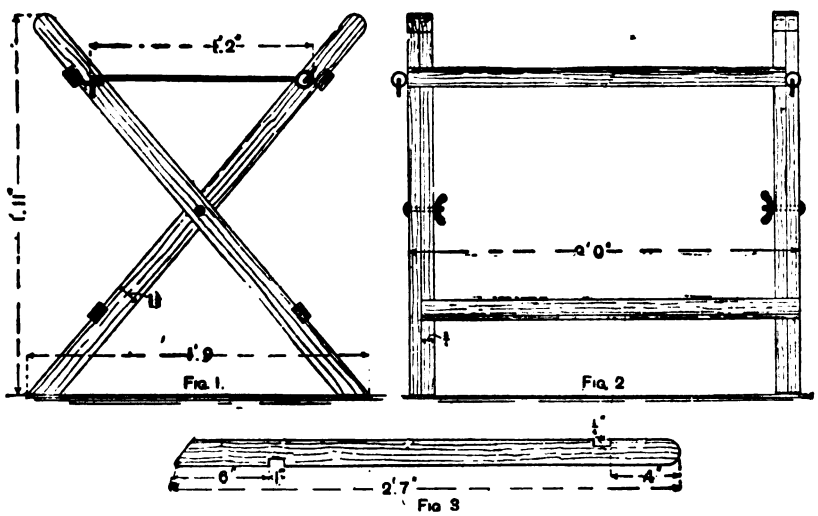
How to Polish a Coffin.—The following is a good method of polishing a coffin. Coat with linseed oil, and fill in with a paste of best Paris white (not plaster-of-Paris) and turpentine, coloured with yellow ochre for pitch-pine and oak, and with a mixture of brown umber and ochre for elm. A very small quantity of polish is mixed with this to assist it in setting. Rub the filling well in across the grain with a piece of coarse rag or a wisp of long tow, and then rub off all superfluous filler and leave it smooth and clean. The whole body of the coffin, including the lid, should be so treated, and should then be allowed to stand as long as is convenient—the longer the better. Another good filler is plaster-of-Paris, oil, and polish, but it is not so easily used, as it sets quickly; with this filler do only a very little at a time, or it will set and get muddy before it can be rubbed off. The polishing may be commenced as soon as the work is all filled in; start with the side first filled in. Make a big rubber of wadding, wet it well with polish, and cover with a piece of rag; put a little oil on with the finger and lay the polish on with long, straight strokes, not attempting to work it, but taking care not to leave any wet streaks. After two or three rubbers of polish have been applied begin to work it, but unless the coffin is panelled do not try circular work, but use sweeping strokes 3 ft. or 4 ft. long with a sort of twist at each end; do not scrub backward and forward over the same spot. Do not be afraid to use oil on the rubber at this stage. When a fair body has been obtained on one side, turn the coffin over and do the other, working the head and foot as well. When the second side has about as much polish as the first, turn back to the first side, and with very fine worn glasspaper remove any small lumps. If the filling is well done the grain hardly ever rises, except on damp or coarse-grained stuff; therefore the old plan of papering half the polish off to get the grain down is avoided by this method. Now quite body up a side—that is, as well as time and price will allow—and then finish it off, if the atmosphere is reasonably warm, with a few coats of very thin glaze. When this side is done satisfactorily, treat the other in the same manner, finishing the ends with the second side. The lid must be well bodied in and its mouldings glazed off, but the top should be spirited out. When a good body has been applied, wet the rubber with half polish, a sprinkling of spirit, and a little oil so that it works freely; continue to reduce the polish and oil, and increase the spirit, until a fair shine is obtained with the rubber marks showing in oil. Sprinkle a few drops of spirit on a rubber that has not been used for polish, and lay two or three thicknesses of clean rag over the face; rub this on the work until dry, then wet it again and repeat the process; after three or four such rubbers the surface should be well cleaned off and should shine well If time presses, wipe over with a folded rag on which spirit has been sprinkled to clear the grease off more quickly, but, of course, not so well as by thoroughly spiriting out. If too cold to glaze, the body of the wood must be spirited out similarly, but the glaze saves time if it can be used. Always use a large rubber—one with a face as large as the palm of the hand—and do not let it get sodden; but, if necessary, pull it to pieces and tighten it up. For a panelled coffin, the above plan must be modified a little; a smaller rubber must be used, and great care must be taken to get into all the corners; the glaze finish is suitable for this also. Note the time spent on different portions of the work; a fair division would be to allow about two-thirds of time to the body and one-third, or rather more, to the lid, and take care that about equal time is given to both sides, as upon this a satisfactory result will obviously depend. First decide how much time may be allowed for the job, and then divide it up carefully and stick to it, or one part may look far better than another, a result certainly to be avoided.

Renovating Fur Necklet.—The only practicable method of renovating a fur necklet that is moth-eaten in parts is to cut away the latter. Open the necklet, remove the padding or lining, and place the skin, fur side down, upon a table. Cut out the spoilt part with a sharp knife on the skin side, taking care to cut only through the skin and not the fur below. Now cut to the required size a piece of skin of the same kind as that just removed, place it in position, and sew it in, being careful not to catch in the fur. If a spare piece of the skin is not to hand, sufficient must be cut from one end of the necklet, thus shortening it. A third alternative is to make the necklet of a different shape, neatly joining the small pieces cut off; probably there will then be sufficient to replace the spoilt parts.

Renovating Silvered Glass.—To renovate a glass in one corner of which the silvering has assumed a frosted appearance, or has become spotted by damp, proceed in this manner. Cut out the affected silvering, first marking it off squarely with a straightedge and chisel; lay the glass flat on its face and apply either of the silvering solutions given on p. 108. Mix equal parts of (*a*) and (*b*), and pour upon the clear glass, allowing the solution to flow evenly over the bare place. Distilled water should be used, and the solutions should be kept in black bottles.

Soluble Prussian Blue used in Inks.—In many ink recipes soluble Prussian blue, which is a preparation of Prussian blue and ferrocyanide of potassium, is mentioned. This soluble blue is made thus. With a pestle and mortar thoroughly incorporate a quantity of ordinary Prussian blue with half its quantity of ferrocyanide of potassium. The mixture is then put into distilled water and thoroughly shaken from time to time; then it is allowed to stand and the sediment filtered off.

Folding Stand for Baby's Cradle.—Figs. 1 and 2 are end and side views respectively of a folding stand for a baby's cradle. To make the stand, procure four pieces of sound pine, ash, or oak, as preferred, 2 ft. 7 in. long, and plane them to 1¼ in. by ¾ in. These form the ends; set them out as shown at Fig. 3. Four pieces 1 ft. 11 in. long



Folding Stand for Baby's Cradle.

and planed to 1 in. by ¾ in. will now be required for the connecting bars, the ends of which are seen in Fig. 1. The two pieces forming each end are pivoted together by a brass bolt 2½ in. long, with wing nut; the bars are fixed by light screws 1½ in. long. To make the bars on which the cradle rests, heat one end of a piece of ¼-in. bar iron and form a ring on a stout screw eye. Bend the other end at right angles to fit into a corresponding eye, as seen in Fig. 1. When these bars are attached the stand is complete.

Red Oil used in French Polishing.—In making the red oil used in French polishing, the alkanet root is merely broken into small pieces and the oil poured over. If well stirred up a reddish tinge will at once be imparted; leaving the root in the oil overnight will yield a stronger red. The red oil is usually kept in a large jar, more oil or root being added as required. The addition of a little turpentine assists in fetching out the colour if the root is very dry.

Mica and its Uses.—Mica is an anhydrous silicate of calcium and aluminium, and crystallises in a laminated mass, easily split along its axis; it can be subdivided down to $\frac{1}{1000}$ in. in thickness. Deposits of this material are found in various parts of the world. The occurrences of pockets in which mica is found cannot be predicted by the geological formation of the locality. The best quality mica is obtained from India, whence has been furnished the bulk of the world's supply for centuries. These mines, the principal of which is the Abruker mine, are in the interior of the country, remote from civilisation, and extremely inaccessible. Here the deposits are worked now as they were 2,000 years ago. The Abruker mine has been sunk about 200 ft., following the pitch of the vein, and all the mica and refuse are raised and carried away by natives. No machinery of any kind is used; drills and hammers are the only tools employed. The refuse and the mica are placed in baskets which each hold about 10 lb., and which are passed up from hand to hand by women who stand in a line on a ladder. When the top is reached the baskets are dumped and returned down the ladder in the same manner, but by another line of women. The crude mica is first roughly trimmed and then sorted into different grades, according to sizes and qualities. It is then split up, and the size to which it is to be sheared is marked upon it. After shearing, the mica is cleaned, weighed, and packed ready for transport. At the Abruker mine the packages of mica are loaded into carts drawn by bullocks, and carried in this way to seaports hundreds of miles away; the bullocks travel at the rate of about ten miles a day. There are many kinds of mica, prominent among which are Muscovite, the common potash mica; paragonite, an analogous soda variety; biotite, a magnesia mica having a black or dark green colour; phlogopite, a bronze-coloured mica found in crystalline limestone and serpentine rocks; lepidomelane, a black mica containing much iron; and lepidolite, the red-rose or lilac lithia mica. Mica has many uses, its chief perhaps being in the electrical industry. The fact that mica is elastic and fireproof, and that its insulating qualities are unaffected by time, has made it peculiarly adapted for use with electrical machinery. It has been used for vibrating plates in the photophone, and for diaphragms in telephone construction. In commutator work mica is almost indispensable, as also is the case in hundreds of other electrical machines and instruments. For the purpose of armature insulation in high-tension alternating machines mica is especially adapted; unfortunately the expense of the mineral has to a great extent prohibited its use. Mica waste has one or two electrical uses. Insulators are made by splitting up the mica into laminæ and solidifying these thin sheets at a high temperature and under a heavy pressure. It is claimed that this treatment increases the insulating properties of the mica. Mica replaces glass in positions exposed to much heat, is used in wallpaper varnish, and in packings for machinery; it has many other applications.

Making Glass Beads.—In making small glass beads, a portion of melted glass, coloured or uncoloured, is taken from the crucible upon the end of a long iron blowpipe; the melted glass is then blown into a thick bulb, to which another iron is attached exactly opposite to the first. The bulb is drawn out into a long narrow tube by two men, who pull the two pipes asunder. The narrow tube, many feet in length, is laid upon supports. The tube is cut into very short lengths to form the beads. If the beads are to be rounded they are either heated in an iron vessel kept in constant motion to prevent the beads adhering to each other while the edges just fuse, or they are revolved in a vessel with water, when the edges are rounded by mutual attrition.

Blackening of Silver Goods by Gas.—The coal gas used for lighting will sometimes cause silver and plated goods kept near the gas burners to become discoloured. This blackening is caused by the presence of sulphuretted hydrogen in the gas. No special form of burner will prevent the blackening of the silver if the gas is impure, though the use of an incandescent burner will lessen the evil, because a smaller quantity of gas will be consumed. If the sulphuretted hydrogen cannot be removed from the gas before it is sent out from the gas-works, a small purifier filled with slaked lime, through which the gas must be passed, should be fixed on the premises. This lime would remove the sulphuretted hydrogen. The spent lime should be removed from time to time, and fresh lime put in its place.

Brass Money Box.—To make a brass savings bank or money box (Fig. 1), cut a piece of sheet brass 11½ in. long by 4 in. wide. Clean it with emery-cloth, planish, bend it round over a mandrel, and braze the ends together, using borax as a flux. File the joint smooth, and raise two swagings on it, each to be 1½ in. distant from the ends. This constitutes the body. For the foot, cut a disc of brass 5½ in. in diameter, and hollow it on a block so that it resembles an inverted saucer. Swage this about ½ in. distant from its edges, and cut a 2-in. hole out of the centre. Now file the edges perfectly plane, and solder the body on, having first fixed it in the centre. The top

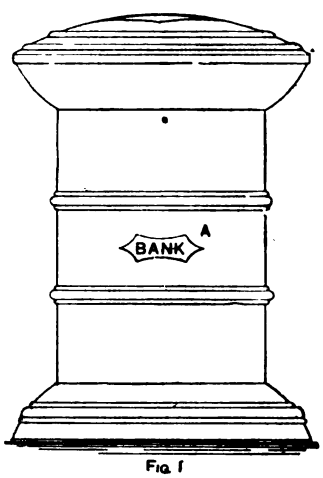


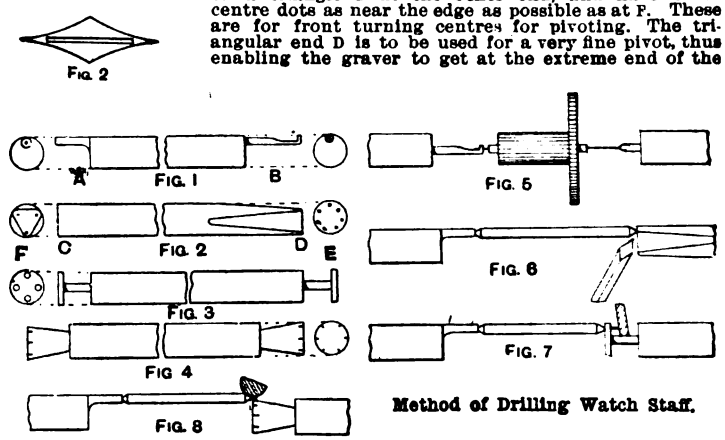
Fig. 1

Brass Money Box.

is made by cutting two discs of brass each 5½ in. in diameter, and hollowing them together on a block, to resemble a shallow bowl. File the edges of these perfectly plane, and swage one about ½ in. distant from the edge, afterwards jennying up a small edge. In this, the top hollow, cut a central slot to allow a large coin to pass through easily. Now file the bottom hollow, so that when an edge has been jennyed up it will fit tightly into the top. Cut a 3-in. hole out of the centre, and solder both hollows together, afterwards fixing the top over the centre of the body and soldering round. A small slot plate (Fig. 2) will show to better advantage if made of German silver. File it so that any coin can pass through easily, hollow it slightly to fit the top, and after fixing it in the centre solder it on. Now, if desirable, cut a name-plate A (Fig. 1) of German silver, and stamp or etch the name on; then fit it to the body, and solder it on. Cut a disc of brass about 3 in. in diameter, to be soldered underneath the foot over the 2-in. hole. When full, the bank can be emptied by unsoldering this disc, without in any way injuring the bank. Scrape off superfluous solder, and clean with emery and oil.

How to Bronze a Frieze.—Here are instructions on bronzing a Cordelova (imitation plaster) frieze. Apply to the frieze two coats of oil paint. For the bronze colour, mix in oil ½ lb. of burnt umber, ½ lb. of Brunswick green, and add Venetian red until a good bronze colour is obtained. A penny that has been in circulation for a year or two may be used as a colour test. Thin the colour with half varnish and half boiled oil, and give the frieze a good coat. On the following day, while the frieze is still tacky, apply bronze powder (copper, silver, or gold) to the parts of the frieze in relief. A paper-hanger's roller covered with plush can be used for this purpose. Run the plush-covered roller through the bronze and then over the parts of the frieze that are in relief. A white coat brushed over with knotting thinned with methylated spirit gives a good imitation of old ivory.

Using Watchmaker's Turns for Drilling a Staff, etc.—Below is described how to drill watch staffs for fine pivoting. The centres sold with a new pair of turns are of very limited use, so, when buying, a length of brass rod and a length of steel rod to fit them should also be purchased. From these rods proper runners for turning and pivoting balance staffs, etc., are made. The brass and the steel rods should be cut up into 3-in. pieces, each piece to form a runner. One steel runner, to be used as a back centre, should be filed up as at A (Fig. 1), and a minute centre marked upon it with a fine centre punch. This is for general use in turning staffs and pinions. The other end of the runner may have a hole drilled near its edge, and a brass pin B (Fig. 1) inserted in the hole: a small hole, through which a pivot can be passed, must be drilled through the thin end of the pin. This is a safety back centre to be used in turning a staff, cylinder, or pinion that has a fine pivot, which might break if its end rested in the centre A; by passing the pivot through the hole in B the strain of turning is taken by the shoulder of the pivot only. A steel runner should have fine centre punch dots round the end C (Fig. 2), as at E, and be filed to a triangle D at the other end, and have three centre dots as near the edge as possible as at F. These are for front turning centres for pivoting. The triangular end D is to be used for a very fine pivot, thus enabling the graver to get at the extreme end of the



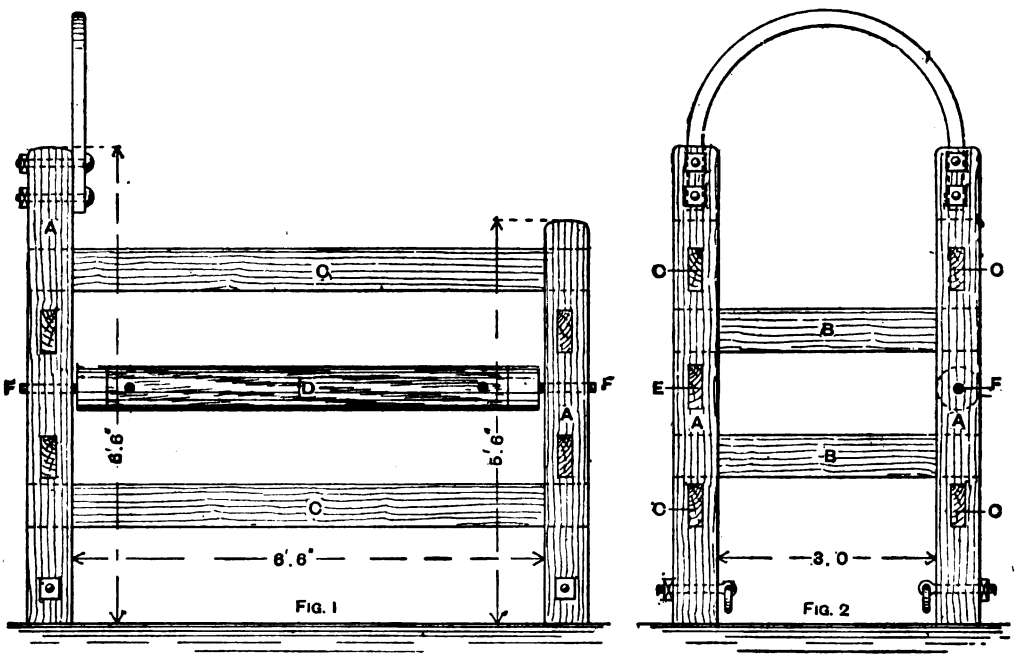
Method of Drilling Watch Staff.

pivot. A brass runner should be filed at both ends, as shown in Fig. 3, small holes of graduated sizes being drilled through its end, through which pivots can be passed to round up and burnish their ends. Another brass runner should be filed at each end, as shown in Fig. 4, slight grooves in which pivots can lie during polishing with oilstone dust and red-stuff being made at the ends; one end should be kept for oilstone dust and the other end for red stuff. For drilling staffs and pinions, a central hole must be drilled in a brass runner and a short drill made and inserted friction-tight. The back pivot of the staff or pinion runs in a brass safety centre like B (Fig. 1), but in the centre of a runner. The work is revolved by a bow against the drill, which is held to it by the right hand, and slowly revolved to keep it true. Before drilling, the broken pivot is filed off flat, the centre carefully marked by a pointed chamfering tool, and care is taken that the drill is started in this centre. Fig. 5 shows a pinion being drilled with the parts in position. Fig. 6 shows a pivot being turned on a staff. Fig. 7 shows a pivot being rounded up with a file. Fig. 8 shows a pivot being polished by a steel polisher. In all these illustrations the bow and ferrule are omitted for the sake of clearness.

The Use of Fusible Plugs.—A fusible plug is a brass case containing a core of an alloy that will melt at a temperature a little higher than the heat of the water or steam in the boiler. It is practically impossible for the core to refuse to melt if the boiler runs sufficiently short of water to leave the plug exposed to the fire heat only, though, owing to ignorance, the plug might be placed where the fire could not readily act on it. If deposit inside the boiler covers the plug it may melt before its time. A fusible plug is also an element of safety when there is danger by excessive pressure, for as the pressure increases so does the heat of the water or steam, and when the latter reaches a temperature higher than normal the plug will act. Fusible plugs are, of course, no protection when a boiler is weak or develops defects in structure.

Fixing Handle of Walking Stick.—It is often required to fix the horn head of a walking stick or umbrella to an iron screw dowel that is firmly fixed in the stick itself, the joint being covered by a silver band. As a rule, the hole in the horn handle has worn too large for the dowel screw to grip, and if so a new screw of larger gauge is necessary. Screw the horn on the screw first. If the screw is tight and there seems danger of splitting the horn, warm the screw in a flame and screw home whilst hot, and then immediately immerse in cold water. There is no cement that will make a firm joint. A wooden plug might be tried, but it will be difficult to get the old screw into it, as the plug will probably wind out. Fill the silver mount with wax cement or sealing wax, and screw the handle up tight whilst the wax is fluid.

Stocks for Shoeing Kicking Horses.—Fig. 1 shows side elevation, and Fig. 2 end elevation, of a set of stocks for use in shoeing horses that kick. The ground is marked out to Figs. 1 and 2, and 7-in. square posts A are sunk in each corner. If the stocks are put up in a building or against a wall there must be clearance (say 2 ft. or 3 ft.) in front for the horse's head. Two cross rails B (Fig. 2) are fixed in front, and, if desired, movable ones at the back, similar to rails seen in stable stalls. The top cross rail in front should come just under the horse's chest. There are also two rails C (Figs. 1 and 2) at each side, as shown; also a roller D (Fig. 1) on the near side, and a centre rail E (Fig. 2) opposite on the off side; the sheet or webbing is strapped round the rail and made a fixture on the roller so that a man at the front and one at the back working the roller lift the horse off its feet, which are strapped to the rings shown at the bottom of the posts. The roller is turned with iron pins F (Fig. 1), like those seen on knacker carts. The bow seen at the top of the front posts is of iron.



Stocks for Shoeing Kicking Horses.

Blackening Brown Boots.—To blacken brown boots and shoes, first clean off all the dye with a strong solution of hot soda water, using a tooth brush. When the dye is removed, rub with a little black dye, which can be bought at most boot repairers' or grindery shops (a pennyworth will be ample). Allow this to dry, rub with a bit of pork fat, which makes the leather soft, and afterwards give the boot a good blacking and polishing.

Taking apart Photographic Lens.—The balsam used as cement between two photographic or other lenses sometimes assumes a sort of fungoid appearance. This, if slight, will practically make no difference to the working of the lens, but it may be removed as follows. Take the lens from its mount (and this removal may necessitate the turning up of the edge of the mount), and place it on a few thicknesses of blotting-paper in a beaker or saucepan. Pour warm water over the lens and keep warm for a time; this will soften the balsam, and the lenses may then be carefully slid apart. Note the positions of the lenses, so that in putting them together again the same sides of the lenses as before may face each other. Clean the lenses with benzole. Now place a lens, concave surface up, on a warm plate, and drop into it a spot of balsam free from bubbles, and lower upon it the convex surface of the other lens, and gently but firmly press well together till the excess oozes out. Put in a clamp or bind up together until dry. On heating, the balsam should remain hard. On resetting the lens, the fungoid appearance will most likely have disappeared.

Gums used by French Polishers.—Shellac forms the foundation of most polishes and spirit varnish. Garnet lac is a very dark variety useful for "black" or varnish for japanning purposes. Orange shellac has many grades, from common to best. Lemon shellac is for best work. White or bleached shellac is used for decorative work, such as polishing inlaid work and fancy woods that are to be kept light in colour. It is best to mix the lac when in solution. Gums such as benzoin, sandarach, and mastic are not absolutely necessary in polishes; their object is to gain a bright surface with a minimum of trouble. The addition of such gums and resin converts a simple polish, easy to manipulate, into a varnish difficult to use with a rubber without an undue quantity of oil.

Using Mixed Jet for Limelight.—A mixed jet can be used for oxygen and coal gas, and the light would be about the same as a blow-through jet with the same gases. The hydrogen should be rather more than 2 to 1 of oxygen, and the best proportion is being used when the best light is obtained. With coal gas and oxygen, use about 10 of gas to 8 of oxygen; here, again, turn on the oxygen till the best light results. If oxygen cannot be obtained at a definite pressure from a bag, fill a bag with coal gas also, and leave both in a double set of pressure boards under the same pressure. Failing this, the pressure of oxygen will commence at 9 in., and will gradually fall to nothing. With an oxygen cylinder the pressure can be regulated to about that of the gas. For preparing oxygen, 2 parts of chlorate to 1 part of oxide of manganese are heated in a retort. Wright recommends 2 lb. of chlorate to ½ lb. oxide of manganese and 6 oz. of common salt, because the oxygen comes off from this mixture very regularly. 1 lb. of the first mixture yields about 4,800 cub. in. of oxygen, and 1 lb. of the second mixture yields about 5,000 cub. in. To compress the mixture, powder and moisten it with water first.

Mechanism of Perpetual Calendar Watch.—Fig. 1 shows the arrangement of a perpetual calendar dial. At the top is the month hand; on the right is the date hand; on the left is the day-of-the-week hand. Inside the seconds dial is the moon disc, showing by observation or by the numbers the age of the moon. Fig. 2 shows the mechanism underneath the dial. D is the moon disc. It has two moons, and around its edge are fifty-eight teeth, going round once in two lunar months. It rides loose upon a central pipe, and is driven, one tooth each day, by a pin in the wheel E^1, driven in its turn by the wheel F. F is on the hour wheel of the watch, and goes round once in twelve hours; it has forty teeth. It drives the wheels E^1 and E^2, having eighty teeth each, and going round once in twenty-four hours. The wheels E^1 and E^2, by means of pins projecting from them, as shown, drive the day-of-the-week wheel B and the date wheel C one tooth each day. B has seven and C has thirty-one teeth. The day-of-the-week hand is fastened to the axis of B, and the date hand to the axis of C. A is the month wheel; it has forty-eight teeth, and goes round once in four years. It is driven by the intermediate wheel G, driven in its turn by the date wheel C. Upon A is mounted a steel disc having notches of varying depth in its circumference. Thus, the space representing the month of January is high; February is a deep slot, as it is three days short; March, again, is high; to A, and caused to return, when drawn back each day, by a steel spring, as shown. The month wheel A, day-of-the-week wheel B, date wheel C, and moon disc D are all held in position by spring flirts resting between their teeth, and causing them to jump one tooth accurately each time they are moved. This is but one of many forms of perpetual calendar movements. All are complicated and difficult to make, and even when properly made frequently give trouble.

Curing Birds' Skins.—A preservative used in curing birds' skins consists of 1½ lb. of whiting and ½ lb. of soft soap boiled in 1 pt. of water, with the addition of ½ oz. of chloride of lime and ½ oz. of tincture of musk. This recipe works out at less than a farthing for a starling or blackbird. Instead of musk, tincture of camphor might be used; it is a little cheaper but not so good. In using the preservative it is painted on the inside of the skins; then the "stuffing" is done.

Polishing Ebony Fretwork.—The polishing should be wholly or three parts done before the fret-cutting is begun. After sawing the wood, fix it to a firm flat bench and plane the surface smooth; then proceed with the cutting, drilling the entering holes for the saw from the face. Ordinary work may be finished by using various grades of emery cloth down to a fineness of 00, the final polish

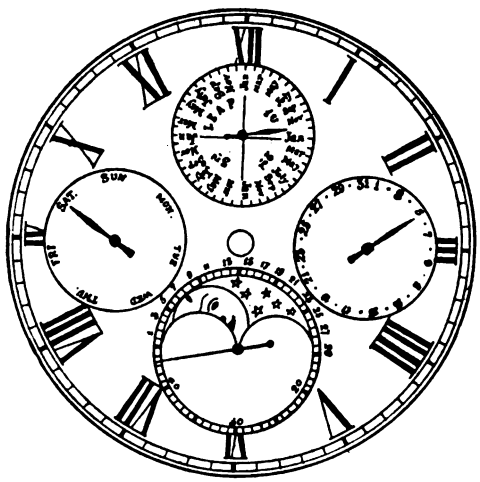


FIG. 1

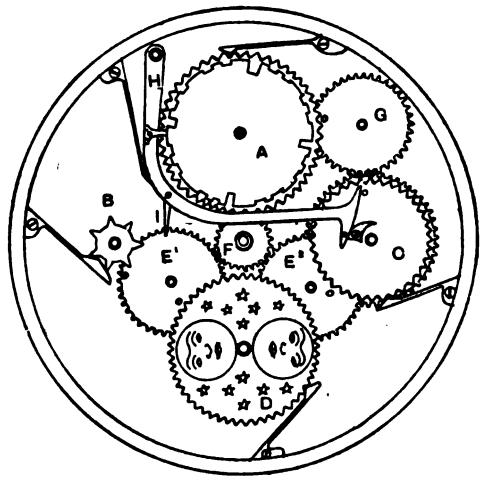


FIG. 2

Mechanism of Perpetual Calendar Watch.

April is a shallow notch, being one day short; and so on. It will be noticed that three Februaries are deep notches (three days short, or twenty-eight days), and one February is not so deep, being two days short, or twenty-nine days in leap year. The lever H, a finger on which enters these notches, regulates the number of days shown for each month by operating on a projecting pin on the date wheel C. The position of the lever H with regard to the wheel C varies according to whether its finger piece rests in a deep or a shallow notch of A. Thus, when resting on a high space, or a thirty-one-day month, the cam shown on C passes the lever without disturbing it at the end of the month. But when the lever H is resting in a notch, it projects farther over C, and the cam comes in contact with it one, two, or three days, as the case may be, before the end of the month. The pressure on the cam causes the pin in C to rise and come in the path of the lever H, as the latter is drawn back each day by the impulse pin in E^1 acting on the arm I. Each day when the arm I is released, H springs forward again and ordinarily does nothing, as there is no projecting pin on C; but after the cam on C has come in contact with H, the impulse pin C is caused to rise, and the lever H coming forward forces C round for several teeth. The wheel C is a delicate piece of work. There is a connection between the cam upon it and the impulse pin upon which the lever H acts. The connection is underneath the wheel, and consists of a spring lever. The effect is that, as soon as the cam presses against the end of H, the impulse pin rises from the level of the wheel and stands up in the path of H. It remains in this position until about the middle of the month, when it comes into contact with a fixed stud under C, and is restored to its normal position level with the surface. The lever H is kept up being given by briskly rubbing with a hard brush on which has been placed a little beeswax. Or the following process might be tried. Wrap the emery cloth tightly round a piece of cork 4 in. by 2 in. by 1 in., and rub up and down with the grain of the wood. Great care must be exercised so as not to break off any portion of the more delicate fretwork, and change the grade of the emery cloth as the surface gradually becomes smoother. Should it be preferred the surface may be lightly French polished, using silk for the outside of the rubber in place of ordinary cotton; silk will last longer over the sharp surface of the fretwork.

Photographic Vignettes.—Flashed glass is used for making photographic vignetting glasses, the colour being removed from the centre by rubbing with hydrofluoric acid. The operation is a messy one, however. Cardboard is by far the most convenient material to use for making vignettes, as a fresh one has generally to be cut for each negative. It is not necessary to keep a card vignette moving whilst the negative is printing. The usual plan is to shape the vignette according to the density of the different parts of the negative, to fix it at a greater or less distance from the negative, and, if necessary, to cover it with tissue paper. Many failures have been due no doubt to fixing the card too near the negative; it should be more than ½ in. away, and should lap over where the negative is thin, for there the light will spread rapidly. Sometimes it is advisable to tuck a little cotton-wool under the vignette, giving a loose edge to the wool to avoid a hard line. To make a successful vignette by any method the background must be light; but vignetting is old-fashioned and seldom artistic, and should be avoided if possible.

Enamelling and Polishing Slate.—The slabs of slate are cut to size, shaped, moulded, carved, or incised as may be required, then polished with sand and water to a fine surface. The enamel is then carefully and regularly laid on, or the slab is marbled to a design, then stoved in an oven capable of being heated to 350° F. Some colours require less heat than others. The time necessary for stoving depends on the colour; experience will teach this. The colouring is then polished with rottenstone and sand and, when a very fine finish is required, completed with the hand.

Pattern for Conical Rim.—It is assumed that a copper hoop is to be put round a wooden bucket to ornament it. Below is explained how to draw a plan to which to cut the copper so that it will fit snugly to the shape of the bucket. The pattern wanted is a frustum of a right cone, and to set this out to the correct taper first draw a semi-elevation of the bucket as A B D C (Fig. 1). Next draw the position of the rim F f^1 e E, and from E draw a line E f at right angles to E e, and draw F f^1. With f^1 as centre, and with f^1 F and f^1 f as radii, draw quarter circles F L and f l to represent a quarter plan of the rim. Divide these quarter circles into an equal number of parts, as F, G, H, f, g, h, etc. Join F f, G g, etc., and also join F g, G h, etc., by dotted lines as shown. The lines F f, G g, H h, etc., will be the plans of a series of slants of the cone, and the dotted lines F g, etc., will be the plans of a series of diagonals. F E is the slant of the frustum, and to find the slant of

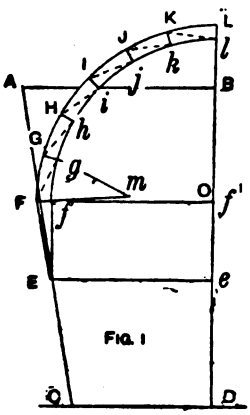


FIG. 1

the diagonal draw a line g m at right angles to the dotted line F g, and make g m equal to the line E f. Draw F m, which will be the true slant of the diagonal. To work the pattern, take the length F E and set off on a straight line as F f on the pattern (Fig. 2). Now take the true slant F m (Fig. 1) of the diagonal as radius, and using F (Fig. 2) as centre, draw arcs to cut g g on each side of the centre line. With f g (Fig. 1) as radius, and f (Fig. 2) as centre, cut the arcs first drawn. Again use the slant F f (Fig. 2) as radius, and with the intersecting arcs g g as centres, describe arcs at the top of the pattern (Fig. 2). With F G as radius, and F as centre, cut the arc last drawn. Repeat this method of working for each division on the plan (Fig. 1), using the small and large divisions and slants and diagonals in their proper order, and make the number of divisions on the complete pattern equal to four times the number on the quarter plan; or if the rim is made in two pieces the divisions would be as shown by the accompanying patterns.

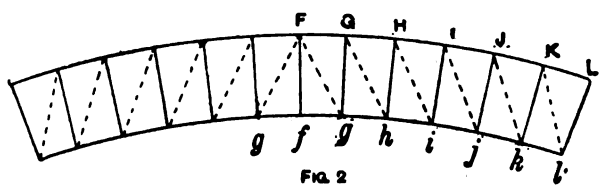


FIG. 2

Pattern for Conical Rim.

Making Shaving Paste.—Shaving pastes are made, as a rule, from fine soft soaps composed of potash and lard. To make crème d'amande, dissolve 1 lb. of caustic potash in 1 pt. of water. Melt down in a pan 3 lb. of lard and add to it gradually the potash lye, stirring thoroughly during the addition. Boil and stir well for some time, and continue adding the lye until the mass becomes pasty, and a small portion taken from the pan works smoothly and free from greasiness when it is dipped in water and worked between the fingers. The addition of the lye may then be stopped. Beat the soap in a mortar and with the pestle till it is cold, when it will have a satiny appearance. Add sufficient essence of almonds during the beating.

Making Albumen Paper.—Albumenised printing-out paper is made by coating a suitable paper with albumen containing a soluble chloride. Rives paper is generally employed, and what is known as 10 kilo should be chosen. Most of the albumen used commercially for this work is obtained from the blood of animals, but a small consumer will find egg albumen more suitable. The albumen of one egg will coat two sheets of paper, but to cover the dish that must be used to the depth of about ½ in., about twenty eggs will be required. The paper may be coated in quarter sheets. The whites of the eggs must be thoroughly separated from the yolks, no trace of the yolks being in the coating solution. Tap the shell on the edge of a cup to crack it, hold the crack uppermost, and, placing the thumbs in the crack, pull in two and pour the yolk from one half shell to the other. While this is being done, the white will of itself fall into the cup below. Pour the whites one by one into a deep vessel, add 8 gr. per ounce of ammonium chloride, and beat to a froth with an egg whisk or a bundle of quill pens. Allow the mixture to settle till next day, filter through fine muslin, pour into a flat dish, and, to coat the paper, which is more easily done if it is slightly damp, float it on the solution, lowering the paper at one corner, and pushing it forward along the dish until the whole surface is in contact. Care must be taken to avoid air bubbles, as such spots cannot be sensitised. If the paper is at all dry it will curl back off the solution. The paper may be tinted with Judson's dyes, if desired. For double albumenised paper, immerse after the first coating in a solution of 4 parts methylated spirit and 1 part water, then give a second coating of albumen. The paper is sensitised just before use by floating on a solution of silver nitrate 50 gr. to the ounce.

Defects of Gas-meters.—When the floats of wet gas-meters are being soldered together, the air inside the floats becomes rarefied owing to the increased temperature caused by the heat of the bolt used in soldering. When this inside air is cooled by the water in the meter, the pressure of the outside air upon the float becomes so great that any sudden slight increase of pressure will frequently overcome the resistance of the metal, which is only soft pewter. Floats should always be made with egg-shaped ends instead of flat ends, so as to offer more resistance. In dry gas-meters the faces of the hard white metal valves sometimes become coated with a deposit, caused probably by the action of the gas on the oil used to keep the diaphragms soft. In course of time this deposit hardens until the pressure of the gas is insufficient to move the valve cover. The top of the meter and the top of the valve-box inside should be taken off, and the valve covers taken out and thoroughly cleaned with a little naphtha, the faces of the valves being treated in the same manner; the meter should then be put together again and be re-tested and stamped by an authorised inspector. The only remedy is to soften the diaphragms with an oil that is not affected by the particular gas in use.

Manufacture of Lucifer Matches.—The tipping composition for "strike-anywhere" matches consists of red phosphorus with other ingredients as follow. (1) Phosphorus 1 part, chlorate of potash 8 parts, glue 4 parts, whiting 2 parts, powdered glass 8 parts, water 22 parts. (2) Phosphorus 2 parts, chlorate of potash 5 parts, glue 3 parts, red lead 1½ parts, water 12 parts. Safety matches have no phosphorus on the tip, but it is contained in the rubber. For tipping safety matches, use (1) Chlorate of potash 1 part, glue 2 parts, sulphide of antimony 1 part, water 12 parts. (2) Chlorate of potash 4 parts, bichromate of potash 1½ parts, red lead 4 parts, sulphide of antimony 3 parts, with sufficient glue and water to form a paste. The rubber on the box is treated with phosphorus 2 parts, powdered glass 1 part, mixed with sufficient glue solution to form a thin fluid while warm. Red phosphorus varies in colour from red to brown; it is formed by heating the ordinary phosphorus to 240° C. or 250° C., either in a closed space or in an inert gas, such as nitrogen or carbonic acid. On heating the red modification to a temperature of 260° C. it changes back to the ordinary phosphorus. Red phosphorus, when freed from the ordinary phosphorus, is non-poisonous, passing through the body unaltered; but red phosphorus is rarely, if ever, free from ordinary phosphorus, and hence cannot be said to be non-injurious. Red phosphorus does not take fire by simple friction like the yellow variety, but must be raised to a temperature of 240° C.

Lenses for Magic Lantern. — Plano-convex lenses are generally used in magic lanterns, two to each condenser, with their convex sides towards each other. The smallest condensers used are 4 in. in diameter, and this is none too much, as the slide pictures are supposed to be 4 in. in diameter. A single lantern should have a condenser not less than 4½ in. in diameter. Biunials and triples require 4½-in. condensers to allow for the rolling of the curtain, and also a little margin to get the two or three discs coincident on the screen. For the objective, the following lenses are required:— The front combination consists of a double convex lens and a plano-concave lens cemented together. These should be 1⅝ in. to 1¾ in. in diameter. The back combination has two lenses separated by a short space; the one nearest the front is a meniscus, with the convex side towards the front, and the other is a double convex lens of unequal curves, the curve with the longer radius being placed nearest the light. These lenses should be 2 in. in diameter. An objective of this description has a focus of about 6 in. and gives the best results. When, however, an objective of very long focus is required, a single achromatic answers nearly as well; but it must be sufficiently large to take all the rays of light. A single lens of 12-in. focus should be at least 3 in. in diameter.

Constructing a Bamboo Bedstead.—Fig. 1 shows the foot of a bamboo bedstead, 3 ft. wide and 3 ft. 10 in. high; Figs. 2 and 3 are alternative designs for the head. The framework of each of these sections must be made from canes 1¾ in. to 2 in. in diameter, and great care must be taken in making the joints and seeing that the dowels are a good fit. A (Figs. 1, 2, and 3) is a piece of beech 7 in. wide and 1¼ in. thick. This must be fitted in position 1 ft. above the ground before the filling work is commenced, and should be securely fastened with round-headed screws passed through the legs and cross rails into the wood. The strength of the bedstead in a great measure depends on the firmness of this piece of wood, as on it are fastened the angles by which the head and foot are stretched. The filling work can next be proceeded with, care being taken that every joint is strong and a perfect fit. Fig. 2 shows a design suitable for an upholstered back, 7 ft. 9 in. high; if preferred, similar work to that shown in Fig. 3 can be used. For the bedstead bottom, iron fittings similar to those used for wood bedsteads are advised. Fig. 4 is a sketch of the iron angle, and B (Fig. 2) shows the position in which the angles are placed. They are securely fastened to the wood with screws, and the stretchers and laths are attached in the usual manner.

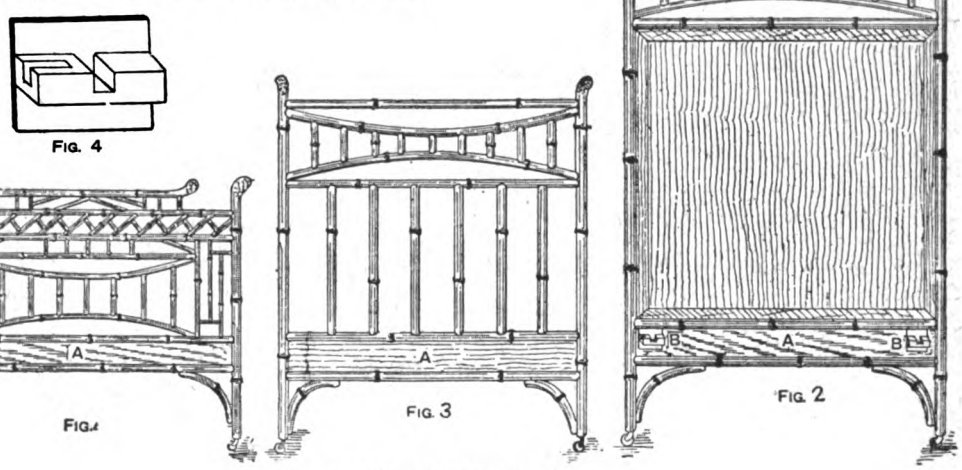


FIG. 4 FIG. 3 FIG. 2

Constructing a Bamboo Bedstead.

Removing Stain from Polished Wood.—A soda-water stain on polished wood should be wiped over with linseed oil as soon as noticed. If left unoiled, the only alternative is to repolish, first removing the damaged polish by rubbing with No. 1 glasspaper and oil. If this treatment is not a success, use spirit instead of oil.

Making Plumbago Crucible.—In making a crucible with a quantity of plumbago dust, mix the plumbago with an equal weight of fireclay, and add water while kneading to form a stiff dough. Keep this in a cool place for a few days, and work it from time to time, when it will become less sticky and more plastic; the clay should be almost too stiff to work by the hand when it is ready for moulding. For this, use an iron mould with a plug attached to a handle. The mould should be filled with the clay and the plug hammered in, to form the hollow of the crucible. It is kept in a warm place for a few days, when the crucible will leave the mould, and may be turned out. It is dried in a warm place for several weeks, and gradually heated when it is used for the first time.

Varnishing Photographic Negatives. — The retouching of a negative should always, if possible, be done before varnishing, such portions of the negative as are to be operated on being covered with a retouching medium. This medium may be purchased, or may be made of gum dammar 96 gr., turpentine 1 oz. If it is preferred to varnish before retouching, the varnished negative must be rubbed down with powdered resin to give a surface on which the retouching pencil can be used. The following varnish is recommended. Sandarach ½ oz., seed lac ¼ oz., castor oil 80 drops, oil of lavender 40 drops, alcohol 10 oz. Powder the resins and dissolve in the alcohol, and add the rest of the ingredients. Warm the negative till it is as hot as can be comfortably borne by the back of the hand, pour a pool of varnish in the centre of the plate, and let it flow first to the top right-hand corner, next to the top left-hand corner, then to bottom left-hand corner, almost touching the thumb, and pour off the excess at the bottom right-hand corner into the bottle. The negative should not be rocked. If the varnish is inclined to be streaky it is too thick, and more alcohol must be added. Conduct the whole operation as slowly as possible. Drain thoroughly, and bake the varnished negative in front of the fire or over a gas jet till the varnish is quite hard. Heat the negative evenly or it will crack. The negative should be held by the extreme corner with the thumb and forefinger of the left hand, unless it is larger than half plate.

Colouring Gold.—The simplest method of colouring gold jewellery is to bring it to a uniform heat, allow to cool (and thus become annealed), and then boil until bright in a pickle of 8 oz. of rain water and 1 oz. of sulphuric acid. Another method is to anneal the gold, boil it in a pickle of nitric acid and water, again anneal, and dip in the following colouring mixture. Two parts (by weight) of saltpetre and 1 part of table salt are heated in their dry state in a colouring pot or blacklead crucible; when hot, make into a paste with hot water, boil, add 1½ parts of muriatic acid, and stir well. Use at boiling point; leave the gold in the solution for not more than 90 seconds, as the solution removes more or less of the gold. On taking the gold from the colouring solution, rinse it in a pickle, dip it in hot water, and dry in hot sawdust: the gold will be spotted if not thoroughly dried. This method may be used with gold ranging between 12 and 20 carats fine, the best results being obtained with 15-carat gold.

The Preparation of Chromic Acid.—Chromic acid (H_2CrO_4) is produced by two or three methods. In one, 2 parts (by measure) of a cold saturated solution of bichromate of potassia are mixed with 8 parts of sulphuric acid; on cooling, the chromic acid is deposited in crystals, the mother liquor being then decanted. Perhaps the method of producing chromic acid more generally followed commercially is to decompose chromium sulphate with lime and to heat to redness the resultant paste of lime, gypsum, and chromium oxide. The chromate of lime formed is treated with sodium sulphate to yield soluble sodium chromate and gypsum. The addition of sulphuric acid liberates the chromic acid. A less wasteful process than this is the electrolytic one now being worked in Germany by Lucius & Bruning. In a solution of chromium sulphate in sulphuric acid are immersed both lead anode and lead cathode, chromic acid being liberated on the former and hydrogen on the latter. A current at 3·5 volts with a current density of 300 ampères per square metre is required, the cells being at the temperature of 50° C. (122° F.).

Making a Bone Apple-scoop.—In every sheep there are two bones specially suited for making apple-scoops, and with them only a small amount of trouble is left for the workman. The shank bones of Welsh or other mountain sheep are generally preferred for scoops; they make neater articles. But for larger scoops the shank bones of sheep of the larger breeds come in handy. To clean the bones, boil, say, for from half to three-quarters of an hour; too much boiling is liable to cause the head of the bone to slip off. With a tenon saw or a butcher's meat saw, on the flat side of the bone, as at A

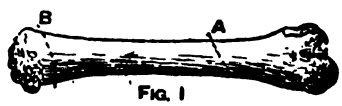


Fig. 1


Fig. 2

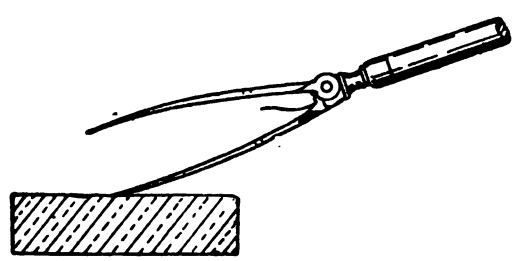
Making a Bone Apple-scoop.

(Fig. 1), make a shallow cut just deep enough to reach to the hollow containing the marrow. Next saw off the lower end of the bone, as at B. All the bone from the middle of the front between A and B has then to be chipped out. For this purpose, use a ½-in. gouge, and afterwards a small chisel driven with a mallet; or a knife can be used, but then the work will take much longer. To cut the bone now left remaining to the shape of Fig. 2, use a half-round file. The two sides of the front and the circuit of the point must be brought to a sharp edge, as by these the apple is cut. Whilst the bone is being worked it will be sure to show more or less grease; this can be removed by a rag dipped in whiting, or by a crumpled-up piece of blotting paper. To extract the marrow from the hollow above A (Fig. 1), use a bit of crooked wire and a few small rolls of blotting paper. The opening should then be stopped with a neatly-fitting piece of cork, tucked in tightly. To finish, smooth the bone with glasspaper and polish with whiting.

Putting Sash Lines in Window Frames.—Before beginning to replace broken sash lines, carefully lower the top sash to see whether the breakage is at one or both of the lines. The ½-in. bead of the side at which the line is to be restored must be removed, a blunt chisel being used; a broad chisel bruises less than a narrow one. Begin the prising of the bead from the back, as, though the paint must be broken, it need not be defaced more than necessary. The lower sash can then be removed and the old line cleared with pincers or a blunt chisel. If the upper sash line is broken it is often best first to remove the line from the lower sash so that it may be put out of the way. The parting bead must next be removed, and pincers are better than a chisel for this. Sometimes a chisel, used to cut the paint at the lower half of the bead, is an advantage. Remove the pocket piece and take out the weight and old cord. If it is difficult to remove the weight, it is sometimes possible to tie a new line without removal. The new line is passed through the sash pulley by means of a "mouse," a piece of lead not thicker than the line and about 2 in. long, to which a fine strong twine is affixed; the twine is hitched to the sash line twice or thrice and the mouse is entered through the pulley, drawn through the pocket, and the line pulled through by its aid. If the weight is still in the sash frame, the line can be inserted in the weight by drawing through the mouse and making a knot. Lift the weight as high as possible and fix the line so that the sash will just reach the sill. Superfluous line is often a hindrance to proper working of windows, as the line always stretches in use. The replacing of the pocket piece can be done before the line is fixed to the sash, and, in the case of the lower sash, the parting bead can also be put in. The ½-in. or stop bead should be sprung in by getting nails nearest the ends in first. Sometimes they will need shortening, but no nails ought to be removed, and all should be guided to their holes, first those nearest the ends, and then those at the middle. If needful, a nail or panel pin may be inserted, but this is not necessary unless the bead springs away from its place. Care must be taken to strike on the old nails or the stopping will come out and the bead be made unsightly.

Condensation from Under Side of Iron Roof.—The dropping of water from the under side of a corrugated iron roof is caused by the moisture of the warm atmosphere of the room condensing on the colder surface of the iron roof, and this condensation, of course, goes on more rapidly during frosty weather. The remedy is to fix at the bottom of each sheet of iron a small half-round gutter to catch the water. Lead it to one end of the roof, and bring it to the ground by a down pipe. A lining of slag wool or silicate cotton supported by matchboard will prevent the condensation sometimes.

How to Set a Ruling Pen.—By taking out the screw of the ruling pen and looking directly at the point of the pen, it will be seen whether the worn point has a flattened surface. If so, place the pen on an oilstone (fine



Method of Setting a Ruling Pen.

Turkey preferred) in the position shown in the sketch, apply a little oil, move the pen backwards and forwards at the same time slightly rocking it horizontally and vertically. Wipe and examine the pen occasionally, and stop just short of bringing the point to a sharp edge. If one point of the pen has been injured and is shorter than the other, hold the pen upright on the stone and grind both points level before removing the screw and setting the pen. If the points are too sharp, the pen will cut the paper, and it will be necessary to take off the keen edge by using it for a few minutes on a piece of brown paper.

Making Photographic Printing-out Paper.—No one, unless he is likely to be a large consumer and able to afford a proper apparatus, should attempt to make P.O.P. The paper is sold so cheaply that it could only be made in large quantities at the same price; and expensive plant and long experience are necessary to ensure good results. Prepare two solutions. (A) Ammonium chloride 50 gr., Nelson's No. 1 gelatine 160 gr., Heinrich's hard gelatine 300 gr., distilled water 20 oz. (B) Silver nitrate 150 gr., distilled water 4 oz. Dissolve the gelatine in 4 oz. of water, warm and add the remainder; then add solution (B) a little at a time, stirring thoroughly between the additions. Allow the emulsion so formed to set, then wash by squeezing through mosquito netting, and washing or soaking in a few changes of distilled water. The shreds must then be well drained, melted down, and the emulsion is ready for use. The paper is unrolled over the surface of the emulsion, which is placed in a trough or a dish tilted to an angle.

Cutting Blinds.—Linen or art print blinds are cut upon a large flat table, using a long straightedge and marking awl. Equal width at top and bottom can be secured by folding the stuff so as to prick both at once; squaring must either be done by a large square working on a trued edge of board or by folding the blind (when made parallel) edge to edge and pricking through. Lines are made with a marking awl, and for cutting some use shears, others a knife and straightedge. Whenever possible, cut off the selvedges. Blind cloths vary in width; prints are made in every 6 in. from 30 in. to 60 in.; unions in almost every 2 in. in saleable widths.

Making Cells for Optical Work.—By following these instructions amateurs who have a small lathe not adapted for screw-cutting, and who are not adepts in the use of chasers, can make the brass cells and similar work for microscopes, telescopes, etc. The apparatus here described will turn and cut the threads without displacement, thus ensuring perfect centreing, without which the best lenses will give unsatisfactory results. To hold the cells, etc., use boxwood chucks fixed on iron face-plates. A hole is drilled truly in the centre of the chuck while in the lathe. Into this hole fits a turned iron or steel mandrel of the shape shown at Figs. 1 and 2. The part O should be a tight working fit in the boxwood chuck. The poppet end of the mandrel has a thread cut on it of a pitch suitable for optical work. Fig. 3 shows the complete mandrel and tool-rest. The hole B (Fig. 2) is tapped to receive the screw that regulates the cut of the tool, while into the hole A (Fig. 2) slides the guide; and the set-screw B (Fig. 3) takes up any shake in the rest. To complete the tool-rest, pieces F (Fig. 3) to carry the tool and G for the handle end will be required. The ordinary poppet must be discarded; in its place use a wrought- or cast-iron poppet, made as shown in Figs. 4, 5, and 6. The hole H (Figs. 4 and 5) receives the bush I (Fig. 6), which is drilled and tapped to suit the screwed end of the mandrel M. J and K are nuts, and L is a handle made fast to the mandrel; it actuates the cut of the tool longitudinally. N (Figs. 4, 5, and 6) is the hole used for bolting down the poppet. When facing, boring, or turning a cell, etc., the nut J is released and the nut K is

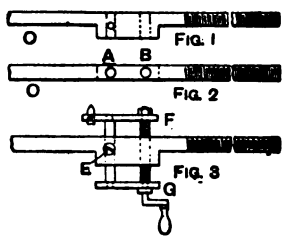


FIG. 1 FIG. 2 FIG. 3

jammed; then I can revolve, the cut being regulated by the handle L. When thread-cutting, the lathe spindle carrying the chuck must be fixed so that it will not turn; then the nut J is jammed tight, thus fixing I, the cut being actuated by the handle L. The thread may be started at any point desired. Fig. 7 shows the complete apparatus, with letter references as before. If the use of a lathe is not to be had, the apparatus will still be of use, but in that case all operations of turning and screw-cutting must be managed by the handle L, while the work remains at rest. The sketches are not to scale, and the apparatus must be made to suit the lathe in use.

The Manufacture of Glue.—Glue, size, and gelatine are varieties of the same substance; they differ only in the quantity of moisture and of impurities which they contain. Glue contains so many impurities that it is unsuited for use other than as an adhesive for wood, paper, etc. Gelatine-yielding substances are legion, those in commercial use including the skins of all animals, tendons, intestines, bladders, bones, hoofs, and horns. In the preparation of ordinary glue, great use is made of the parings and cuttings of hides from tan-yards; tanned leather is useless for the purpose. Briefly, the process consists in boiling the animal matter and straining the product into coolers, where it thickens into a jelly. This is cut into sheets of suitable thickness and dried in the open air on frames of wire netting. Spring and autumn are the most suitable times for drying the glue, the frost of winter and the dry heat of summer having injurious effects. The size is not dried, but is sold just as it is cut from the coolers. In making size and glue from shredded skins (chiefly those of rabbits), the processes in vogue at a large factory in America are as follow. 350 lb. of shredded skin and about 400 pailfuls of water are put into a wooden vat and boiled for two hours, the material being well stirred every fifteen or twenty minutes to prevent it settling. The liquid is then run off from the bottom of the vat and strained in a press which may be about 4 ft. square, 3 ft. high, and made of wooden slats. The interior of the press is lined with bagging, and through this material the liquid is strained or pressed by means of a hydraulic jack. The hot strained liquid drops into a vat below, whence it is conducted by means of hose into barrels. In from eight to ten hours the stuff is cool, and has a skin formed on the top; in warm weather ice is laid on this skin to harden it; this is size. For making glue, the strained liquid is run into coolers, these being wooden troughs lined with zinc, and in twelve hours' time the material, then in the form of jelly, is loosened from the trough by running a wire along it, the wire being bent to conform with the rectangular section of the trough. The block of jelly is cut up into cakes, and these are then sliced in an arrangement of fine wires stretched tightly across an iron frame about ¼in. apart; this frame is drawn through the jelly. The drying frames upon which the slices of jelly are then placed are about 5 ft. 6 in. long and 2 ft. wide, and are made of galvanised wire netting. The frames, when full, are placed in racks through which the air can circulate freely. It takes but a few days for the jelly to dry in a cool west wind, though a system of artificial drying, by means of which the size becomes glue in but a few hours, is now being practised. In drying, the material shrinks to one-half its former bulk. The hard glue is now washed to remove dust, etc., and to produce a glazed appearance. In some factories the cakes of glue are cut up into small pieces by means of two rotary knives, each making 300 revolutions per minute. First the glue is passed between two 4-in. toothed rollers which hold it in position and draw it forward after each stroke of the knife. In England the raw material, before being boiled, is limed; this treatment is not necessary in the case of hide cuttings from leather dressers and tanners, scrap

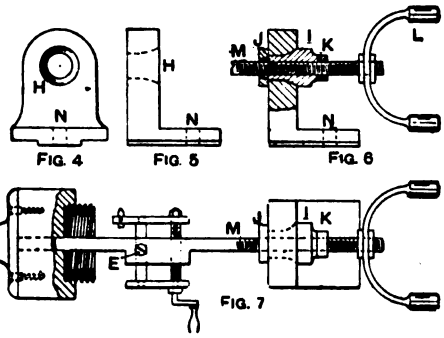


FIG. 4 FIG. 5 FIG. 6 FIG. 7

Making Cells for Optical Work.

from trotter-boilers, dry glue pieces and parchment cuttings, which are already limed. The liming is effected by soaking the material in milk of lime contained in pits. Afterwards it is necessary to remove or kill the lime by washing with water in vats or pits or even in revolving drums. The lime in old glue pieces is killed sufficiently by the action of the atmospheric carbonic acid, the glue being spread out in trays so as to be more readily affected. In some works the washed materials are subjected to heavy pressure, but in others the boiling is proceeded with at once. The boilers or pans generally have each a capacity of several tons. A false bottom of bars keeps a clear space at the bottom. In the middle of the boiler is a removable vertical framework, and its object, like that of the false bottom, is partly to give free space, so that the boiling liquid can circulate thoroughly, and partly to simplify the straining of the liquid. The pans are heated by a fire beneath, by steam, or by the two together. In placing the materials in the pans, any horn "sloughs" that may be used are built up around the central framework, the rest of the material being then put in. During the boiling intermittent stirring is necessary, and the fat which rises to the surface has to be skimmed off. The charge for the pans is in the proportion of twelve tons of fleshings to one ton of water. On the completion of the boiling, the fire is put out or the heat is otherwise removed; a time is allowed for partial settling and cooling, and the liquid is then drawn off through a wooden channel from the space beneath the false bottom. In this wooden channel are lumps of alum, and the liquid glue is conducted to cooling troughs, where it is allowed to cool and harden into a jelly or size. The succeeding processes by which the size becomes glue resemble those practised in America and previously noted. The methods outlined above admit of endless variations, nearly every manufacturer adopting a system that in some particular differs from that adopted by his fellows.

Soldering Gun Barrels.—Cramps are generally used for holding gun barrels together during soldering, although they can be bound together as a makeshift with stout binding wire. The heat is applied with iron or copper heaters, which are placed inside the barrels. The best flux for the purpose is sal-ammoniac. Baker's preparation can also be used as a soldering fluid.

Fixing Needle to Compass Card.—Large compass cards often have two needles, in which case the agate cap is fixed in the card. In small cards the agate cap is fixed in the centre of the needle. Draw a pencil line on the under side of the card from N. to S. points. Fix the needle to this with sealing wax or glue, and screw or rivet through the card.

Cabinet for Beadwork.—The cabinet or workbox here described is suitable for holding beadwork articles. It can be made of deal, and almost enough wood can be obtained from an old cube-sugar box; this, when sandpapered, stained, and varnished, will repay the time and labour expended. The following pieces will be required for the top case A (Figs. 1, 2, and 3). Two, 11½ in. by 7 in. by ½ in., for the top and bottom; two, 10 in. by 7 in. by ½ in., for the sides; two, 10½ in. by 6½ in. by ½ in., for the shelves; one, 10 in. by 6½ in. by ½ in., for the vertical partition; six, 5 in. by 3 in. by ½ in., for the fronts of the drawers; twelve, 6½ in. by 3 in. by ½ in., for the sides of the drawers; six, 4½ in. by 3 in. by ½ in., for the backs of the drawers. The bottom for the drawers should be cut to fit the inside of the framework. The racks B (Figs. 1, 2, and 3) are 7 in. by 1 in. by ½ in., and should have three holes bored in them to hold the tools. To make the desk C (Fig. 3), use two pieces of wood, each 15 in. by 4 in. by ½ in., for the sides; one piece, 8½ in. by 10½ in. by ½ in., for the top; one, 10½ in. by 15 in. by ½ in., for the bottom; one, 10½ in. by 1½ in. by ½ in., for the back; one, 10½ in. by 3 in. by ½ in., for the front of the drawer; two pieces, 14½ in. by 3 in. by ½ in., for the sides of the drawer; and one piece, 10 in. by 3 in. by ½ in., for the back of the drawer. To make the case, nail the top and bottom to the sides of the case A (Fig. 1). The partition and shelves are notched so that they will fit in flush with one another. The partition should be nailed to the top and bottom of the case, as should the shelves to the sides. The last are nailed to the top and bottom, and the case A is fastened to C by nails or (preferably) screws. The back, when fastened in, holds the top and bottom together. In C six holes should be cut to hold the saucers; these should be ½ in. deep and 1 in. in diameter. The fronts of the drawers are rebated so that the sides will fit into them. After making the drawers, bore a hole in the centre of each of the fronts and glue a knob in to serve as a handle. The bottom drawer should have a partition in the centre, so that there will be a drawer for the finished articles; the other part can be used for the wire, etc. It would be advisable to label each drawer with the name of the beads it is intended to hold. The labels can be of paper glued on, or of tin nailed on; or if the necessary skill be possessed an attempt may be made at painting the name on the front of each drawer, the black letters being on a rectangular background of white. If glue also is used it will make the case look much stronger.

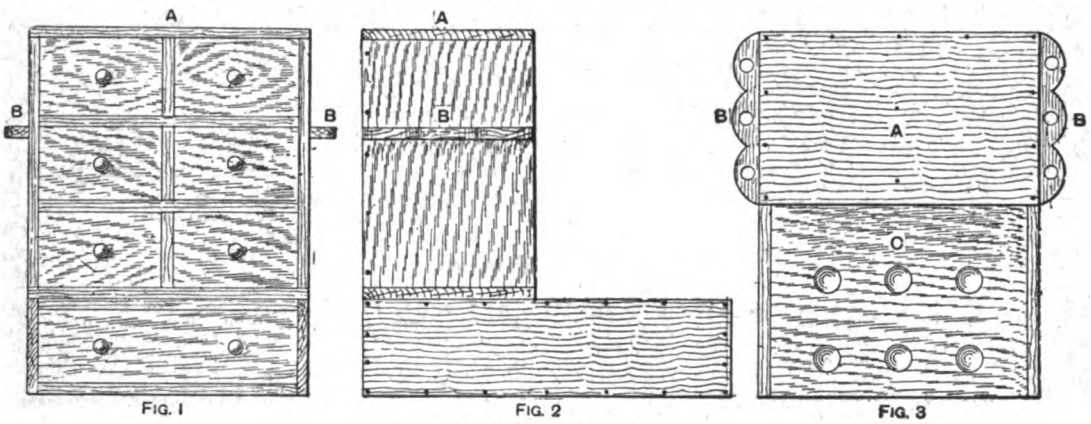


FIG. 1 FIG. 2 FIG. 3

Cabinet for Beadwork.

The Preparation of Crocus.—Crocus is an abrasive material used as a polishing medium for many metals. By one method of preparing it, a mixture of salt and sulphate of iron is put into a shallow crucible and exposed to a red heat; vapour escapes, and the mass fuses. When vapour ceases to be given off remove the crucible and allow it to cool. If the heat is too intense the oxide of iron produced will have a black colour. The mass, when cold, is pulverised and washed to separate the sulphate of soda. The crocus powder is then to be submitted to a process of careful elutriation, and the finer particles reserved for the final stages of polishing processes. A somewhat similar method of preparing crocus is to heat sulphate of iron alone in an iron pan; constantly stir with an iron spatula after fusion until it is thoroughly dry and drops into a pale yellow powder. This is then powdered in a mortar and sifted, placed in a fresh crucible, and calcined. On cooling, the crocus appears as a red powder. The colour of the crocus varies from pale red to brownish red, blue, and violet, the colour being determined by the particular degree of heat to which it was raised during its manufacture; the greater the heat the darker in colour and harder is the material; thus a pale red (rouge) is used for gold and silver, while violet, known as "steel red," is employed for polishing steel. To obtain the best results with crocus, it should be ground as fine as possible, and then washed with water. Three clean glasses are used for the latter purpose, one being filled with water; a quantity of crocus is well stirred in with a wooden stick, left to stand for about thirty seconds, and the fluid is then carefully decanted into the second glass, leaving a sediment at the bottom of the first; after two minutes in the second glass the fluid is decanted into the third, where it is left for several hours to permit the complete settling of the powder. The sediment contained in the first glass is too coarse to be of use; that in the second is a crocus of a finer quality; while that in the third is of the best grade. Crocus of varying degrees of fineness may be obtained on this principle. The material requires to dry slowly to be fit for use. It is advisable to moisten the dried powder with alcohol, and then to ignite it so that all traces of fat may be burnt. For this purpose the crocus should be contained in an iron pan. An excellent crocus powder for applying to razor strops can be made by igniting in a crucible a mixture of equal parts of well-dried green vitriol and common salt. Take care that the material does not boil over in a pasty state and be lost. When well made, out of contact with the air, it has the lustre of freshly cut blacklead. After grinding, elutriating, and drying, a powder is produced that, by applying to a smooth buff-leather strap, may form a serviceable razor strop, or by being mixed with hog's lard or tallow may make a useful polishing paste for many kinds of metal.

Brush Marks in Enamelling.—In using air-drying enamels on cycles great difficulty is sometimes experienced in getting a surface that is entirely free from brush marks. Assuming that the enamels are not stoved, the trouble may be due to one of the following causes. First, the brush may be too stiff; use a very soft brush with a big head and long hair. Secondly, the enamel may not be sufficiently thinned; add a little turpentine, when the coat of enamel will be thinner and more uniform, but not so lustrous. Thirdly, the enamel may dry too quickly; this is often the case with enamel paints, many of them showing signs of drying immediately after they are laid on, and such enamels show brush marks very strongly.

Repairing Mackintosh.—If the water penetrates the mackintosh in a few places only, obtain from a rubber warehouse some rubber cloth in the piece as near like the coat as possible; also get some rubber solution. Cut the rubber into circles large enough to cover the leaks, spread the rubber solution upon them, and also upon the mackintosh inside wherever a leak occurs, and press the circles of rubber into place. Press under a weight for a day or two. The mackintosh should be thoroughly dry before being treated.

Boots Cracking Across the Toes.—All boots, and more especially ill-fitting boots, have a tendency to crease and crack across the toes, and to counteract this tendency the following precautions should be observed. Patent leather boots should always be rubbed down across the joint over the toes while the foot is slightly bent, the rubbing being done with the hand or with a piece of soft rag. If the weather is at all cold, the boots should be warmed in front of the fire before they are put on, and then rubbed. Calf leather boots should always be carefully treed up when cleaning them, and each time the boots are worn the creases should be taken out by rubbing with a bone.

Moulds for Casting Brass.—In making moulds for fine brasswork, ordinary sand should be mixed with loam, which is a more clayey sand. The mould must be well dried before a fire, and then dusted with very fine charcoal powder. If a very delicate surface is desired, it could be smoked over with a pitch torch. This method is more troublesome, but the results are excellent. The patterns must be inserted after the smoking, and the two faces brought together again. The soot from the smoking will give a perfectly smooth surface, and the castings will come out clear and sharp.

Testing a Try-square.—Below is given a method of testing a carpenter's square. Shoot the edge of a piece of board quite straight, apply the square as shown at A (Fig. 1), and draw a line; then turn

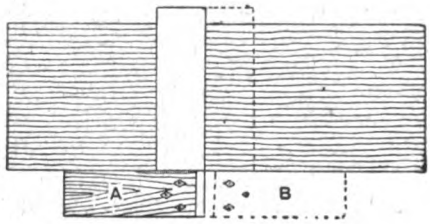


FIG. 1

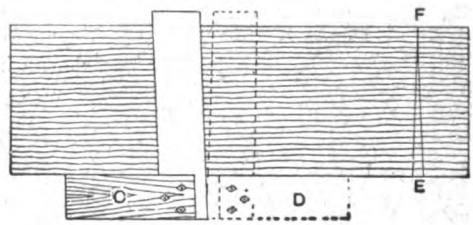


FIG. 2

Testing a Try-square.

the square as at B, and if it is true the blade should fit the line; if it is less than a right angle it will be as shown at C D (Fig. 2), and if more than a right angle the defect will be as indicated at E F (Fig. 2). If the blade has moved or has been knocked out of truth through a fall, it should be knocked back into its proper position and, when true, the rivets should be tightened by careful hammering. If the blade is quite fast in the stock, but untrue, it must be filed true to the stock.

Prevention of Nodules on Electrotypes.—Warty nodules on the edges of electrotypes are usually caused by the employment of small currents. This may happen by using a small cell or small elements in the cell, or by the employment of connecting wires having a high resistance. It is unusual to find these nodules on edges protected with paraffin, and their existence points to a soiling of the parts whilst blackleading the mould. When these nodules are troublesome, it is usual to take out the moulds, cut or file off the warts, give the copper a dip in nitric acid to clean it, then re-immerse the electrotype, and proceed with the deposition.

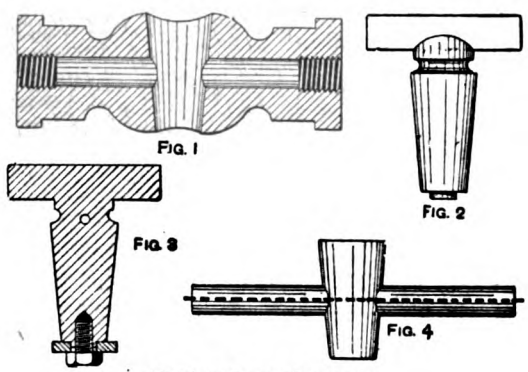
Coloured Varnishes for Straw Hats.—All straw hat varnishes are required to dry in a few minutes and form a firm, pliant, and elastic cover, though a high lustre is not essential. Hence spirit varnish is particularly suitable; any desired colour is gained by the addition of pigments soluble in alcohol, the coal tar (aniline) colours being best adapted for this purpose. Generally, the manufacturer of straw hat varnish prepares two or three colourless stock varnishes which may be coloured as occasion requires. Shellac is the indispensable gum for every spirit varnish, but it cannot, owing to its brown colour, furnish a white or pale varnish, so it is suitable only for dark coloured varnish. A good stock varnish from which black, brown, dark green, deep blue, and similar tones may be made is obtained from 180 grammes of shellac, 45 grammes of soft Manila copal, 45 grammes of sandarach or resin, 1 gramme of castor oil, and sufficient methylic alcohol to form a suitable solution. To produce coloured varnishes from this the respective alcohol soluble aniline colour alone need be added. Ivory black, spirit blue, Bismarck brown, aniline yellow, brilliant green, safranine, and crystal scarlet are among the colours suitable for this purpose, and by their mixture the most varying tints can be produced. The purest and best of these colours should be used; then only a little colour will be necessary. Straw hat varnish making is throughout a cold process, only careful intermixing, slow digestion to complete the solution, stirring from time to time, and perhaps filtration, being necessary. To the above stock varnish add, to obtain black, 55 grammes of spirit-soluble ivory black per 9 litres of varnish; the shade may be varied beautifully by a slight addition of spirit blue or malachite green. For olive brown, add 15 grammes of brilliant green, 55 grammes of Bismarck brown, and 8 grammes of spirit blue. For olive green, add 28 grammes of brilliant green and 28 grammes of Bismarck brown. For nut brown, add 55 grammes of Bismarck brown and 15 grammes of nicrosine. For mahogany brown, add 28 grammes of Bismarck brown; the colour may be deepened by a little nicrosine. For peacock blue, add 55 grammes of spirit blue and 28 grammes of induline. The above are mostly dark coloured varnishes, for the preparation of which shellac is only suitable. Some lighter coloured solutions will now be given. A white stock varnish suitable for the preparation of light-coloured straw hat varnish is a solution of 27 grammes of sandarach, 9 grammes of elemi-resin, 9 grammes of pine resin, and 2½ grammes of castor oil in 18 centilitres of methylic alcohol. To produce a golden yellow colour, add to 9 litres of this varnish 55 grammes of chrysoidine and 55 grammes of aniline yellow. For pale green, add 55 grammes of brilliant green and 7 grammes of aniline yellow. For medium blue, add 55 grammes of spirit blue. For deep blue, add 55 grammes of spirit blue and 55 grammes of induline. Vary the proportions of these two pigments to obtain other blue tones. For peacock blue, add 5·5 grammes of spirit blue, 28 grammes of induline, and a little brilliant green. For violet, add 28 grammes of methyl violet. For crimson, add 55 grammes of safranine. For chestnut brown, add 55 grammes of safranine and 15 grammes of induline.

Melting Silver in an Open Fire.—Procure a small fireclay crucible in which to melt the silver. For a flux use equal quantities of finely powdered charcoal and sal-ammoniac. Make up a large, bright coal fire in an open grate, and when the fire is quite clear break a hollow space in the centre. In this space place the crucible, and allow it to get red hot; then put in the silver, and draw some of the hot coals closely around and over it. Blow the fire with the bellows until the crucible gets white hot, when the silver will melt, the fusing point being at 1873° F. (1022·7° C.). Then add the flux to clear the surface from scum. Again make the crucible hot, and quickly pour the contents into an iron ingot mould previously made scalding hot. One or two ounces of silver may be melted at a time in this way. The flux may be stirred with a pointed rod of iron previously made red hot.

Particulars of Rectilinear Photographic Lens.—The word rectilinear simply means "right lines," and is a name applied to lenses which do not distort straight lines when such fall near the margins of the plate. Such lenses represent a square as a square, and not like a pin-cushion or a barrel, as is the case with a single lens when the stop is placed respectively behind or before the lens. Consequently, rectilinear lenses are doublets—that is, they have a lens at each end of a tube, with the stop between, thus introducing both kinds of distortion, the one nullifying the other.

Cleaning W.C. Basins.—To clean w.c. basins apply spirit of salts by means of a piece of old rag tied to the end of a stick, and after sufficient time has elapsed for the incrustation to become softened, or partially dissolved, wash with clean water. If the incrustation is very thick, the operation can be hastened by scraping. Any spare acid should be thrown down the drains, as it is a dangerous poison.

Making Brass Gas-cocks.—Here are given full instructions on casting and finishing small brass gas-cocks. The patterns may be of wood or brass, but brass is to be preferred, as it wears much better than wood. Core prints must be turned on the ends of the patterns so that, when moulded, places will be left in the mould in which to insert the core. The patterns must be made sufficiently large to allow for shrinkage and for the metal turned off in finishing. The ends of the core patterns must be exactly the same size as the core print on the brass pattern. Core stocks for each of the cores must be made. The keys may be made in the same manner as the body of the casting. Figs. 1 to 4 give views of the body of the cock and the key in two positions. The key must be sufficiently large to turn down for grinding. Make the moulds, trim them, and they will be ready for finishing. In finishing the cock, use an iron bell chuck or an ordinary brass-turner's chuck. Turn one end of the cock square, and thread the hole with a suitable sized thread. Repeat the operation at the other end of the cock. Skim the cock all over, and face both ends of the keyway. Then turn the hole for the key slightly taper as cast. Now skim the outside of the key casting on the taper similar to that of the hole in the cock, and press the cock on. If it does not go on as it should, skim a little more till it is correct. Square the end off, drill a hole up it, and thread with a screw to carry the small brass screw that holds on the D washer, to prevent the tap being pulled off and to obviate the



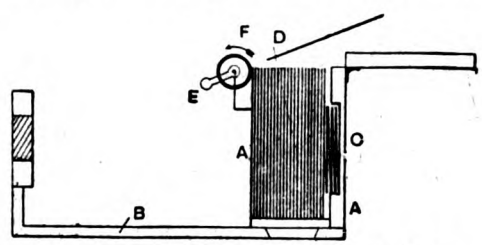
Making Brass Gas-cocks.

escape of gas. Each tap must be turned to each cock, and must be left in it till ground; this will save time and waste. In grinding in, fix the tap in the chuck, place a little loam and water on it, and press on the cock. This will cause the loam to grind down the surface of the key and make a good joint. The common test applied by the workman is to draw out all air by the tongue and mouth, when the cock will, if sound, adhere to the tongue. The key must have a round hole drilled through it, and at the top should be inserted a pin, which catches on the top of the cock and prevents its being turned more than halfway round. In making the sand core, insert a piece of thin iron wire through lengthwise; this will strengthen the core (see Fig. 4). The cores in each case must be made to suit the purpose, and will depend on the size and nature of the cock in hand.

Making Hand-cart for Carrying Furniture.—The cart here described is 6 ft. long by 4 ft. 6 in. wide, and may be used for carrying furniture. As the wheels are to run underneath the bed of the cart, the distance between the springs must be less than is customary in ordinary work. Set out a full-size plan of the cart, mark in the position of the wheels, so that the stock hoop does not project beyond the side of the cart, and mark in the position of the springs or stays to which the axle is fixed, as summers have to be framed in to fix these to. For the outside framing, two rails 2 in. wide by 1¼ in. deep, front and hind bars 2 in. wide by 2½ in. deep, are framed together square and true, and flush on top. This framing is boxed out on the top inner edge, ¾ in. on by ¾ in. deep, to take the boards to form the floor. At such a distance in from the outside as the springs will come, frame in two summers 2½ in. wide, thick enough to be level with the boxing out on top, and flush with the cross-bars at the bottom. If the cart is to have two handles, these are bolted to the summers; if there is to be only one handle, it is fixed in the centre underneath the bottom to both the hind and front bars. Next bolt on the springs or stays; if springs are used, see that the scroll irons and springs combined are of such a depth that the wheel is 3½ in. clear at the top to the under side of the frame: if iron stays are used, 1 in. clearance will suffice. Having bored on the springs and fixed the axle, put in the bottom boards of red deal ¾ in. thick, the grain of which should run from side to side. To protect the outer corners of the frame, iron corner-plates should be fixed round, about 6 in. each way. The wheels should be about 2 ft. 9 in. high; this would bring the top of the cart about 3 ft. 3 in. from the ground line. To make the cart more useful, portable boards may be fitted round by placing small iron staples on the outside of the frame, and irons on the boards, the irons being so made as to slip into the staples.

Why the Welsbach Mantle gives Light.—The temperature of the incandescent bodies with which a Welsbach mantle is impregnated may be assumed as being about 3500° F. The quality of the light depends to a certain extent on the amount of air admitted, which should be just sufficient to ensure combustion of the gas; the burners employed are constructed on this principle. The quality of the light in an incandescent burner depends on the raising of the finely divided rare earths (thoria, ceria, etc.) to the highest degree of incandescence by the agency of a Bunsen burner, which is constructed in such a manner that the amount of air and gas supplied to the burner are in the proportion which will yield a non-luminous flame and give out sufficient heat to effect the object required.

Stereoscope for Holding a Number of Views.—A simple effective stereoscope for exhibiting a large number of views is shown in the accompanying sketch. The apparatus consists of a box A with sliding adjustment along a wood strip B similar to the usual form



Stereoscope for Holding a Number of Views.

of cheap stereoscope. At the back of the box at C are two spiral springs which sink into a recess. By these springs the front picture is kept in position, whatever number of views the box may contain. Across the front of the box is a rod D worked by a handle E. With this rod turn two rubber-tyred wheels F, one on each side. To use the apparatus, the box is filled with pictures (which should be pasted on thin mounts), and the focus is adjusted for the front picture, which is removed as soon as it is done with by turning the handle in the direction indicated, when the wheels F drag the picture out of the way and it falls into the top. The next picture, pressed forward by the spring, is already in position. This apparatus might easily be constructed in pedestal form if the focal adjustment is effected by means of a long screw with a handle and a nut in the bottom of the box. The changing handle would, of course, be fixed outside by lengthening the rod D.

Depositing Nickel on Wax Moulds.—Before nickel can be deposited on a wax mould so as to get a smooth sheet it is necessary to prepare the mould with black-lead or with bronze powder as for the electrotype process, and first deposit on it a thin film of copper in an electrotype solution. If the object desired is a copy of a design impressed on the face of the mould, it will be advisable to remove the mould to the nickel vat when it has become coated with a very thin film of copper, and deposit the nickel on this film. If the design is not undercut, it may be possible to peel off the film of copper from the nickel; but some difficulty may be experienced in getting a deposit of nickel thick enough to form a plate or sheet, as thick deposits have a tendency to crack, curl up, and peel off. To get a tough coat, the nickel should be deposited slowly with a low-tension current.

Cutting the Top off a Stoneware Jar.—In cutting the top off a stoneware pickle jar, first make an ink mark right round the jar at the place where it is to be cut; then with a *new* triangular file wetted with turpentine make a mark over the ink mark, cutting through the glaze. Enlarge the file mark with a rasp, lubricating with turpentine. It is better to cut through the jar with the rasp, but as this process is very tedious, after cutting halfway through stand the jar in water up to the file mark, and with a chisel and hammer tap on the file mark until the top comes off.

Making Rubber Solution.—With a sharp knife wetted, cut into thin slices 1 oz. of pure Para rubber. Place it in a wide-mouthed bottle, cover it with carbon bisulphide or benzene (coal-tar naphtha), and cork down. Next day the rubber will have swollen considerably and have absorbed most of the liquid; pour on more liquid, and continue the addition until a thick fluid is obtained. One ounce of rubber will make about 1 pt. of solution, which is used as a cement for rubber goods.

Making a Safety Guard for a Circular Saw.—The liability to accident by timber being thrown from the circular saw has necessitated the provision of safety guards. The guard about to be described is simple in construction, efficient, and comparatively inexpensive. Fig. 1 of the accompanying illustrations shows a saw bench with a suitable guard fixed in position; A is the bench, B the saw, C the fence, D a pillar, E radial arm, F the guard hung to the arm and secured by means of a small pin G. The radial arm is held in position by means of a set-screw H. By easing this screw the guard may be turned back out of the way while screws are being changed, or while a saw is being topped in the bench. Immediately underneath the socket of the radial arm there is a collar washer J, which is also held in place by means of a set-screw K. The advantage of this washer is that when the

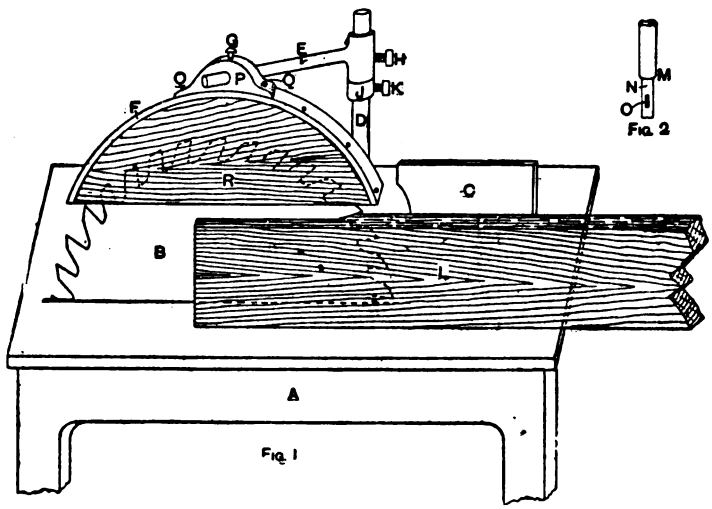


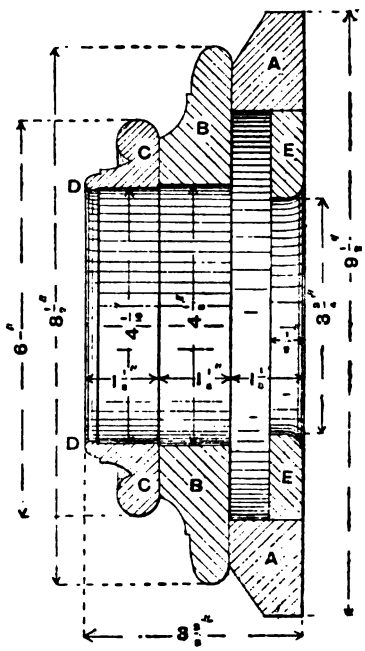
Fig. 1

Fig. 2

Making a Safety Guard for a Circular Saw.

set-screw that secures the radial arm is eased, the washer prevents the socket of the arm from sliding down the pillar. If there were no washer, the left hand would have to be used for holding the arm so as to prevent it sliding down the pillar, when the guard would drop on to the saw. L indicates a piece of timber partly cut by the saw. It will be seen that the guard does not come down on to the piece that is being sawn. The sawyer is therefore able to see the tooth in the cut. This is an important point; for if nothing can be seen of the teeth or cut (as is the case with some guards), it is impossible for the sawyer to see whether the saw is making a true course or not. It will also be seen that this guard may be raised or lowered to suit timber of different depths. There should be two or three guards of different sizes for saws of various diameters. The same radial arm will answer for all the guards. The iron pillar D (Fig. 1, and illustrated by Fig. 2) should be of suitable length, and about 1¼ in. in diameter. At M there is a shoulder that rests square on the top of the table. The part N is square, and there is a cotter-way O to receive a small cotter. Near the outer edge of the table a square hole is made by first boring a hole and then filing it square. The square part N of the pillar should fit nicely in this hole. A cotter is then driven in the cotter-way, which holds the pillar firmly in position. The square prevents the pillar from turning in any direction. The guard F (Fig. 1) is a piece of wrought iron about 1¼ in. wide by ⅛ in. thick, and of suitable length, and drilled to receive the necessary screws and rivets, or small bolts with nuts (see Fig. 1). This piece of iron is bent to the required curve. A piece of iron is now made to the shape shown at P (Fig. 1), or any convenient shape. A hole is made at the centre to receive the radial arm E, and another hole drilled at the top down through the centre to receive a pin that passes down through it and the radial arm, thus securing the guard to the arm. Holes should also be drilled at the ends to secure the piece to the guard by means of small rivets or bolts, shown at Q (Fig. 1), passed through holes in the guard and riveted, or the nuts screwed up tightly, as the case may be. A piece of wood ¼ in. or ⅜ in. thick is now shaped as shown at R (Fig. 1); the bent piece of iron or guard is screwed to this. This piece of wood not only protects the saw but also makes the guard more rigid. The guard is now completed, and when shifting guards, all that has to be done is to withdraw the pin G, place the other guard on the arm, and insert the pin lower, or raise the guard, as the case may be, to suit the diameter of saw or depth of piece that is being sawn.

Turned Wood Case for a Drum Clock.—The useful and ornamental clock case illustrated below is in three separate mouldings A, B, C, and is thus much easier to turn than if it were all in one piece. It can be made in satin walnut, mahogany, oak, etc., but the first is very easy to work, cheap, and, when polished, looks well. Start with the moulding marked A, the



Turned Wood Case for a Drum Clock.

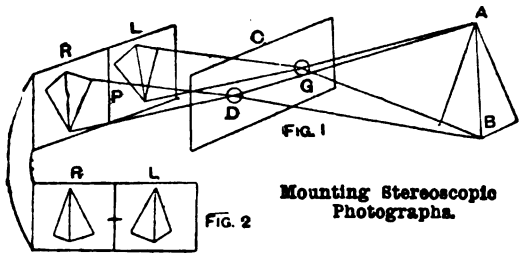
wood for which should be 1¼ in. thick. The back is first planed or turned flat, and the block is then placed on the screw chuck and the outside turned and finished with glasspaper. Then with pencil or compasses strike a circle 6½ in. in diameter and cut right through on the line with a thin parting tool; this inside piece will then be large enough for the top moulding C. The middle moulding B should be made in the same way. For the top moulding C turn and finish the outside, and bore to 3⅛ in. for the inside lip at D, ⅛ in. long. Then place the moulding in a hollow chuck and bore it out to 4⅛ in. by ⅛ in. deep. The sizes given are for the globe drum clocks, costing a shilling or so each. Of course, the inside measurements must be varied according to the size of clock to be fitted. The three mouldings are glued together, three screws 1½ in. long being put through A into B, and three through B into C. Unscrew the ring and legs from the clock, and drive soft wood pegs in place to keep the works from slipping. A ring E, which just overlaps the edge of the clock and fills the space, is not glued in but is held in position by three screws, so that the clock can be removed at any time if required for repairs, etc. A brass plate screwed on the back for hanging the clock completes the case.

Black Streaks in Nickel-plating.—Black streaks in deposits of nickel are caused by bubbles of hydrogen gas, which form in clusters on the surfaces of articles and then burst. They may be prevented by gently agitating the articles whilst being plated, or by stroking the clusters with a stout feather and thus bursting them.

They appear frequently when nickel solutions have not been agitated for some time, and have consequently settled in a stratified condition. It is therefore advisable to stir the solutions occasionally in the evenings, and thus thoroughly mix the contents.

Fitting a Watch Hairspring.—In applying a new hairspring to a watch, the centre coils are broken out, about a quarter of a turn at a time, until there is room for the collet. The effect of this upon the time of the watch can be neglected, as the actual length of spring removed is so small. Now bend a small length sharply inwards for pinning into the collet. Place the collet, right way up, on a broach, and push it on tightly; hold the broach in the left hand, pass the hairspring down the broach, and with the tweezers in the right hand, insert the end of the spring into the hole in the collet. Lay the broach down, with the collet and spring on, and file up a brass pin to fit. Then fix it in and break off the pin, which should previously be half cut through with a pocket-knife.

Mounting Stereoscopic Photographs.—It is sometimes the case when viewing mounted stereoscopic prints that the objects in the background, when seen through the stereoscope, appear in front of the picture. The cause of this may be gathered from a consideration of the following principles. Let A B (Fig. 1) represent a pyramid and C the lens-board of a camera, with lenses D and G forming inverted images R and L on the plate P. Supposing the operator to be standing behind the plate, the image formed by D at R will be similar to that seen by the right eye, and the image formed by G at L similar to that seen by the left eye. Now if a print be taken from this negative by placing a sheet of sensitive paper against the film it will be like



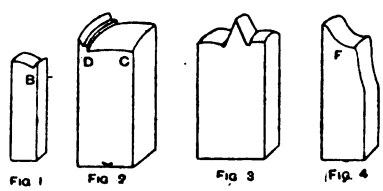
Mounting Stereoscopic Photographs.

Fig. 2—that is, the left-hand view as seen by the left eye will now be on the right, because the images have been turned the right way up. Practically, the reason why the distant objects come forward is that the right eye is looking at the left eye view, and *vice versâ*, owing to the two views not having been transposed in mounting. In mounting stereoscopic prints, to prevent confusion, lay them face down, and run a short line across the back of the paper where the two prints join (see Fig. 2). Trim straight across the two prints for the base line and for the top. Now cut the prints in half and trim to about 2½ in. square, leaving on the right of the right-hand print ⅛ in. more of the picture than appears on the left-hand print, and on the left of the left-hand print ⅛ in. more of the picture than appears on the right-hand print. Now mount the prints about ½ in. apart, with the half-lines on the outside of the print instead of being joined as they were before the print was cut.

Cubing Round Timber.—The easiest way of measuring round timber, to get the solid contents, is to take one-fourth of the middle girth of the timber in inches, square this dimension, multiply by the length in feet, and divide by 144; the result is the reputed cubic contents. If the bark is on, make an allowance for it by deducting 1 in. per foot from the actual girth before dividing by 4. Example: Round log of oak 20 ft. long, 18 in. diameter one end and 12 in. the other, girth 48 in. Then 48 in. = 4 ft., 1 in. per foot = 4 in., and 48 − 4 = 44 in.; quarter girth = 11 in., 11 squared = 11 × 11 = 121, and 121 × 20 = 2,420. Then $\frac{2,420}{144}$ = 16·8, say 17 cub. ft.

Copper-plating Model Boat.—Instructions are here given on copper-plating a boat made partly of metal and partly of wood. First well soak the woodwork of the boat in linseed oil to close all the pores and prevent the copper solution penetrating the wood; then expose it to the air for a day or two to oxidise and harden the oil. The part to be coppered must now be coated with blacklead, well brushed in and polished. On this coating the copper will be deposited, therefore the connecting wires must be in close contact with it at several points. Dissolve copper sulphate crystals in hot rain water until the water is saturated with copper, and will not dissolve any more. Allow this to get cold, then add 4 fluid ounces of sulphuric acid to each gallon of solution. Use anode plates of pure copper connected to the copper elements of the battery. Work the solution cold with current from two Daniell cells of ½-gal. capacity. Connect the cells in series (copper of one to zinc of next) to start the deposit, and when the boat is covered with a thin film of copper connect the cells in parallel to finish.

Cutting Shoe Finishers' Irons.—Irons for ironing up the edges of boots and shoes are of various forms, a few of which are shown in the illustrations. They will serve as examples of how irons should be made and recut. The iron is of such importance to the finishing of all classes of work that it is worth while to learn how to cut kit, as it is called, especially by those who are at a distance from any large town. If new irons are to be made, stocks for them must be procured; these stocks are oblong pieces of squared iron, which are ultimately shaped as shown in Figs. 1, 2, 3, and 4, each iron having a stem at the bottom that can be driven into a handle. The better way, however, is to buy the irons already shaped, as they are very cheap, and then a careful recutting produces a good iron. Stocks for some of the smaller irons can be made from the butt or shank ends of files or rasps. A small vice and the necessary files are the tools required. Fig. 1, in which the crease or indentation B produces a bead on the edge of the sole, can be made like all irons of that kind, single and double, in sets in various sizes. The same remark applies to Fig. 2, but in the latter an indentation or crease is thrown upon the welt side. If these two irons are combined in one, the crease at Fig. 1 being placed at C in Fig. 2, a double iron is produced, and a set of such irons would be very useful. They can run up to almost any size, by widening the



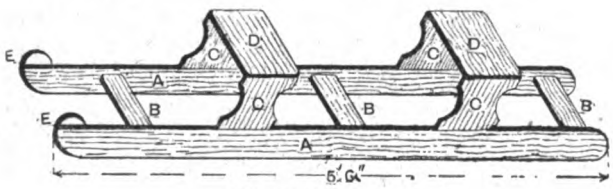
Shoe Finishers' Irons.

space between C and D (Fig. 2) from ¼ in. upwards, increasing the space by $\frac{1}{16}$ in. for each size. Fig. 3 is somewhat like Fig. 1, but with a slightly flatter top. It shows a double pump iron, which is made to fit two thicknesses of edges; it is, in fact, two irons in one, and being larger than one iron only, it retains heat for a longer time. In Fig. 4 the curve marked F can be modified as required; being a waist iron, it is used to set up edges of all kinds, some of which are thin and square, others round, and others of various angles. The files can be bought in sets; they are called kit files, and can be obtained probably at almost any leather grindery stores. These files consist of a four-cornered file, a flat four-sided bastard file, a tapered file, a knife-shaped file, a small rat-tail file, and a triangular file. Jewellers' files of various shapes may also be used, and they come in very handy for cutting different fancy shapes. The rough cutting can be done with coarse files, and the finishing of the shaping process with finer files, a last touch being given with fine kit files. When the proper shape has been obtained the creases can be cut, or the beads squared up with the tapered file, the knife-shaped file, and the small rat-tail file, and the square beads finished with the triangular file. So far, the iron has only been shaped up and roughly finished as far as files can do it; the final finishing and polishing are done with emery powder. Coarse, medium, and flour emery are mixed with oil, the paste being smeared on pieces of leather and the iron rubbed upon it; the coarse emery is followed by the medium and then by the flour emery, the finishing being done with dry flour emery. If the iron is for setting up a stout edge, several pieces of leather are nailed together, and the emery smeared on the topmost one. During the filing operations the greatest care must be taken not to wear away the creases and beads.

Fireproofing Theatre Scenery.—In 3 gal. of water dissolve 1 lb. of alum. With a stock brush thoroughly soak the stretched canvas curtains or other fabric, leaving no part unbrushed. When thoroughly dry, prime in for painting. Another solution consists of 10 per cent. sodium tungstate. Apply as above, and when dry prime in.

Ghost Illusion for Amateur Theatricals. — Paint on canvas a scene representing a room or library, and showing a bookcase. The part of the bookcase that would contain the shelves and books must be cut out of the canvas, the framework only being left, and this framework must be so painted as to have a solid, substantial appearance. The canvas that has been cut out must be replaced by a black net or gauze, and the shelves and books must be painted on the gauze, so that when lighted up from the front the bookcase will appear complete. Behind the gauze and close to it the movable cat cloth is hung. This is a piece of canvas dead black in colour, 12 in. larger all round than the cut-out portion of the bookcase. The ghost or vision stands behind the cat cloth. The light is now turned down in the scene so that the room is darkened, and at the same time a good light is turned on at the back, and is so arranged that it falls on the front of the figure either from the left- or from the right-hand side. While darkening the scene and turning up the lights behind the cat cloth must be pulled up or drawn on one side, and the ghost scene is complete. With judicious management this will answer for tableaux by adding accessories on a large or small scale as may be necessary.

A Simple Sledge.—The accompanying illustration shows a sledge for two persons; it can, however, be shortened to accommodate one person only. It is 5 ft. long, 1 ft. 5 in. wide, and 1 ft. 4½ in. deep, and should be made of red wood, being afterwards painted. The sides A are mortised to receive three rails B, which bind them together; the rails are 3 in. broad. The sides C of the seats are dowelled to the long rails or runners A, and the seats D are nailed down. To stiffen the seats and frame, iron bands should be inserted, one below each seat, each being long enough to allow a screw to be inserted in the runner. A half-round iron strap is carried along the under edge of the runner, and

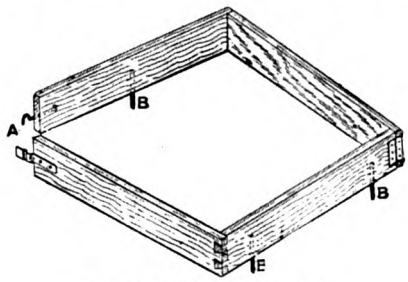


A Simple Sledge.

curled round in the front to form a loop, as at E, to which may be attached the hauling ropes. The following is the quantity of stuff required. Two pieces, 5 ft. by 4½ in. by ¾ in.; three pieces, 1 ft. 5 in. by 3 in. by ¾ in.; four pieces, 11 in. by 9 in. by ¾ in.; and two pieces, 1 ft. 6½ in. by 10 in. by ⅝ in. The following are the positions of the rails and seats. From the nose of the sledge to the first rail is 6 in.; from the inside edge of this rail to the front of the seat is 7 in.; the centre rail is immediately in the centre of the sledge, and the second seat 7 in. from this rail; the back rail is 6 in. from the end.

Painting and Varnishing a Phaeton.—It is supposed that a phaeton is to be repainted black and picked out in red, and then varnished. If the paint is cracked very much, the best plan will be to remove it by means of a gas jet or burning lamp and an old plane-iron. The vehicle may then be filled up and painted. If the paint has only cracked through the varnish, rub it down to the colour with pumice stone and water, then clean off thoroughly and give a coat of colour made of tub white lead and a small portion of driers and lampblack, mixed stiff with raw linseed oil and thinned down with turps; this should dry in about ten hours, but should be allowed to stand a day longer to get hard. In the meantime the wheels, under carriage, etc., should be well rubbed down with glasspaper, and a coat of lead colour applied as above. Any holes or dents in the body should now be filled with a stopper made of dry white lead, gold size, and black japan, beaten up stiff with a mallet or hammer; and the wheels, carriage, and shafts puttied up where required, and afterwards lightly sandpapered off. The body, when the stopper is hard, is faced over very lightly with pumice stone and water to take out the brush marks in the lead colour, after which the whole is given a coat of ground drop black, thinned with turps and varnish; this should dry in about four hours. Then add a good drop of black japan to some of the dead black previously used, and give another coat; let this stand for a day, then give a good hard sponging off, ready for the first coat of japan. If the work is to be finished in a first-class manner, a second coat of japan is necessary; but before applying this the first coat must be flatted down with pumice dust and water on a pad of cloth to remove any nibs which may exist, and to make a dull surface for the next coat, as if two coats were put on without flatting the top coat would "cissy" up and spoil it. If only one coat of japan is given the carriage, etc., will now be ready for lining out; for this, camel- or sable-hair pencils, called fine-liners, and picking-out pencils are used. The colour (vermilion) should be mixed in a small dipper with gold size or varnish to a creamy thickness. Another small pot contains clear turps. The pencil is dipped into the turps, then into the colour, and worked up on the palette; then, holding the pencil between the forefinger and thumb, and using the other fingers as guides, line out as required. When dry, well clean the whole with a sponge, and give the underworks and wheels a light coat of carriage varnish, and the body a coat of under-coating body varnish. After standing two days, well flat the whole as the japan was done, being careful to get out every particle of pumice dust from the corners and crevices, using water freely; then thoroughly dry off, and give the body a good full coat of finishing body varnish, and the under carriage, etc., a coat of pale carriage varnish, putting sufficient on to obtain a good finish without getting runs. To make a successful job, the carriage should be done in a light, roomy place, free from draughts, and kept at a temperature of about 75° F

Stump Moulding.—The following supplements the information on stump moulding given on p. 36. Stump moulding is so called because the moulder works on a small bench called a "stump." The box parts used are about 18 in. square and 3 in. deep. The best are of mahogany or other hard wood to combine lightness and strength; they are hinged at one corner, and have a fastening at the opposite corner, as at A in the accompanying illustration. The hinges and fittings



Box for Stump Moulding.

may be of brass. The other two corners of the box are dovetailed together. The box parts are fitted together in pairs, the bottom part being made to take the pegs B. The moulder takes the bottom part, brings the ends A together, and secures them. He rams it up on a pattern plate or an oddside, and then rams the other box with the top part on the other side of the pattern plate or the other oddside. The two box parts are then put together and moved off the bench or stump to the floor. The corner A is unfastened, and the box parts are opened and removed, leaving the sand mould on the floor ready for pouring in the iron. It will be seen that only one pair of box parts will be required to make any quantity of moulds on this principle. Of course, this method is only suitable for use in casting comparatively small articles such as cast heel-tips for boots.

Colouring Gold.—The following pickle has been found very satisfactory for imparting a rich colour to gold rings, scarf-pins, etc. Alum (powdered) 1 oz., common salt 1 oz., saltpetre 2 oz., and water 10 oz. Wash the article to be coloured in warm water to which a few drops (say fifteen to twenty drops to a breakfast-cup full of water) of ammonia have been added, using a soft brush and soap. Rinse in cold water, and dry in hot sawdust. Then immerse the article in the pickle for about two minutes, and again dry in hot sawdust. Finally polish with rouge.

Hints on the Use of a Kodak.—The ordinary pocket kodak takes pictures 2 in. by 1½ in., and the folding and newer kodak takes pictures 3¼ in. by 2½ in. When closed, the folding kodak measures only 1¼ in. in thickness. These cameras, having a fixed focus (that is, allowing of no adjustment of the focus for near objects at different distances), are unsuitable for any but fairly distant views, where the variation in focus is very considerably less than with near objects at varying distances, because everything beyond a certain distance is more or less in focus. This result is obtained with a short focus lens and a small stop, but as the latter means long exposure, and as short ones are essential to good hand camera work, the fixed focus patterns cannot altogether be recommended.

Portable Dog-kennel.—One-inch grooved and tongued boards 6 in. wide is a suitable material of which to make the portable dog-kennel illustrated by Fig. 1. The boards of the sides should be nailed to a 1¼-in. by 2-in. ledge at the top and a 3-in. by 1¼-in. ledge at the bottom (see K and L, Fig. 2). The boards of the front and back should be nailed to similar ledges, as shown at I and F (Fig. 1). The boards forming each side of the roof should be nailed to the three bearers M, N, and O (Fig. 2). Fig. 3 shows the construction of the floor. It will be seen that the kennel will be composed of seven main pieces. A fillet about 1¼ in. by 1½ in. should be nailed to each end of the sides, as shown in the longitudinal section (Fig. 2), and also by the enlarged section (Fig. 4); this is taken through A (Fig. 1). B (Fig. 4) shows a portion of the boarding of the side with the angle fillet D nailed to it. The front and back can be fixed to the sides by eight 2½-in. by ¼-in. bolts and nuts, as shown at Figs. 1 and 2, and indicated by the section, Fig. 4. Each half of the roof can be fixed to the ends by eight bolts and nuts in a similar manner. The floor will rest on the ledges G and H (Fig. 2) round the bottom of the boarding. The roof should be covered with felt.

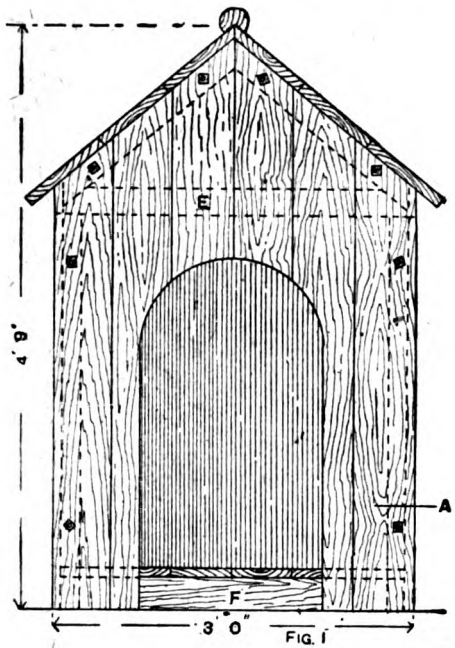


FIG. 1

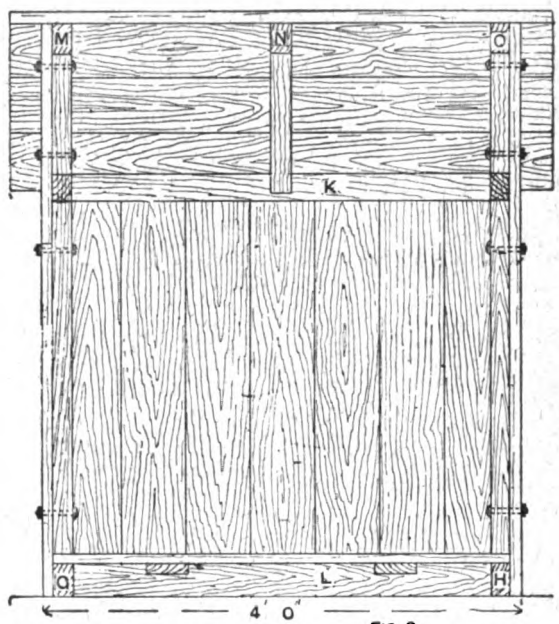


FIG. 2

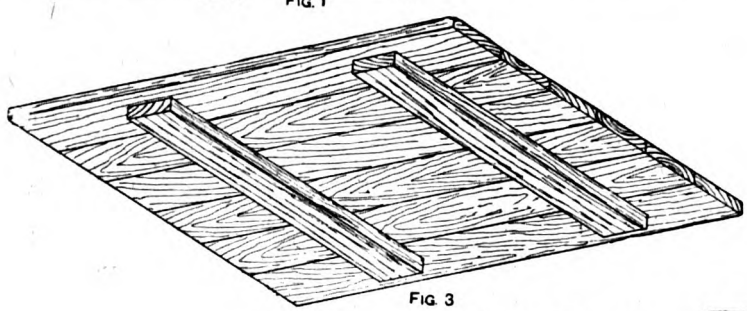


FIG. 3

Portable Dog-kennel.

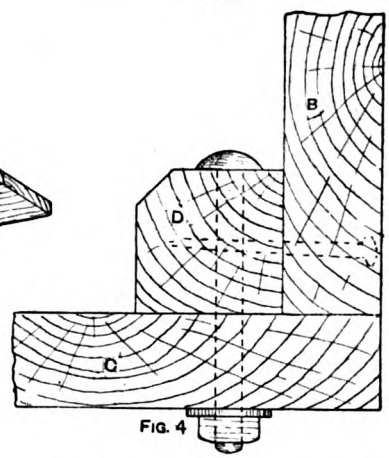


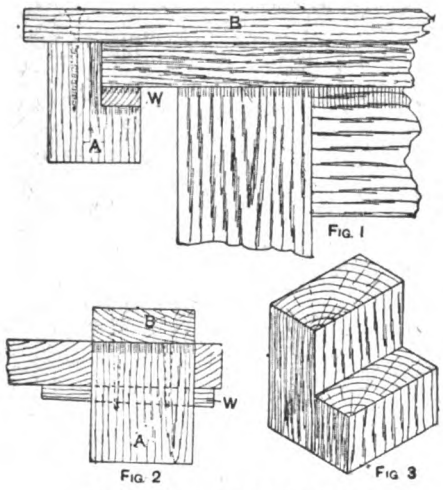
FIG. 4

Blackening Brass.—One method of blackening brass is as follows. Dip the article in a bath consisting of 1 part of sulphate of iron and 1 part of white arsenic dissolved in 12 parts of hydrochloric acid. When the article has become sufficiently black, rinse it well in several changes of cold water to remove the acid, dry in sawdust, and polish with blacklead; it may then be lacquered with a pale lacquer. Another method, and one more generally adopted, although somewhat more expensive, is as follows. Well polish the article with tripoli, and afterwards wash it well in a mixture consisting of 1 part of nitrate of tin and 2 parts of chloride of gold dissolved in a little water and acid. Remove the article and wipe it with a clean linen rag. A slight excess of acid will increase the intensity of the black. The following method will also be found very good, and is the same as that adopted in oxidising silver articles. Give the article a light silver-plating by deposition, in a similar manner to ordinary cheap electro-plated goods. Then prepare a solution made as follows. Dissolve in a little acetic acid 2 dwt. of sulphate of copper, 1 dwt. of nitrate of potash, and 2 dwt. of muriate of ammonia. After warming the articles, apply the solution with a camel-hair pencil or immerse in the bath, then expose them to the fumes of sulphur in a closed box. This may readily be done by placing in a tin biscuit-box a red hot iron bowl, such as the bowl off a small lead ladle, in which are a few pieces of sulphur. Hang the articles on a rod across the tin, and close the lid. It will be necessary to do this where there is a fairly good draught to carry off the sulphur fumes.

Tempering Gun Springs.—In tempering springs for guns and revolvers, make the springs red hot (be careful not to overheat them), then plunge them into cold water. Take them out, warm them over the fire, rub with suet, blaze them over a clear forge fire, and let them cool. The foregoing operation requires considerable practice to produce a desirable temper.

Making Pipe-eye Scroll-irons.—Coachsmiths' barrel heads of scroll-irons, or pipe-eye scroll-irons, are usually made as follows. For an ordinary sized one having an oval stem, take a piece of square edge iron 1 in. by ⅛ in. and well upset one end, making it rather wider than it is thick, setting it in slightly about 1¼ in. from the end to help in forming the eye, and round it off a little. Then make hot a piece of flat iron 1¼ in. by ¼ in. or ⅜ in. thick, according to the width of pipe-eye required, and with the top and bottom fullers set it in to make a round boss; nearly cut it through at the narrow part with the gouge, and weld it on one side of the iron already upset. Make another boss, and repeat the weld for the other side, at the same time working the pipe-eye to shape and size, and working up the oval close to the eye with the fuller so as not to cut in, afterwards using top and bottom oval tools. When the eye is something like the desired shape, punch a small ⅛-in. hole through the centre, gradually making the hole the required size with a steel mandril and working up the round eye in top and bottom tools.

Detachable Lath for Table Top. — The drawings herewith show a simple and effective arrangement for holding a lath to a table top. A cleat A (Figs. 1 and 2) is fixed to the end of the lath B by a couple of screws, as indicated, the cleat and lath being held to the table top by inserting a wedge W, as shown. Fig. 3 is a view



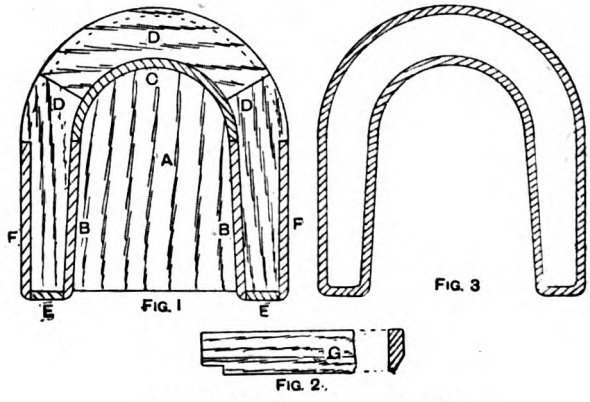
Lath attached to Table Top.

of the cleat; this and the wedge should be made of hardwood.

Calculating Weight, etc., of Copper and Iron Wires. — In calculating the sectional areas of wires, the diameter in inches corresponding to the number of the gauge of the wire must first be determined, and this can be got only from tables. Then to find the area of cross-section in square inches, square the diameter in inches (that is, multiply it by itself), and multiply by ·7854. To find the weight in pounds of a single wire, multiply the cross-section, determined as just described, by the length in inches and by ·28 for iron or by ·31 for copper. To determine approximately the weight in pounds of a stranded cable, multiply the weight of the length of single wire by the number of wires in the strand.

Timing of Watch Hairsprings.—The vibrations of a watch balance occupy exactly equal times (with an average hairspring) only when they are exactly equal in extent. For instance, in a watch with an ordinary flat hairspring, the balance vibrating exactly one whole turn, and going to time lying down, if the power be increased so as to make the vibrations of the balance one and a quarter turns, the watch will no longer be quite on time, but will either lose or gain—probably the latter. In such a case it may be said that the short arcs (one turn) are slower than the long arcs (one and a quarter turns). But in the case of a breguet hairspring (with an overcoil), the spring can be so manipulated as to render the long and short arcs of the balance isochronous—that is, performed in equal times. In such a watch it would not matter whether the balance vibrated one turn or one and a half turns; the time registered would be the same. The average good three-quarter-plate English lever watch, when lying down, has a balance arc of about one and a quarter to one and a half turns, and makes what are termed "long arcs." When hanging up it will make about a quarter of a turn less, say one turn to one and a quarter turns, on account of the greater friction at the balance pivots when in that position. The balance then rests upon the sides of the two pivots instead of resting on the end of one, as in lying down. The watch then makes "short arcs." Obviously, if the short arcs are slow, the watch will go slower when worn in the pocket than when lying on the dressing table at night. But if the hairspring is isochronous, causing the long and short arcs to be performed in equal times, there would be no difference in the timekeeping, whether the watch was worn in the pocket or was kept lying down. Ordinary watches with hairsprings that have not been thus manipulated will lose about one minute per day in the pocket more than when lying down, the short arcs being then known as "sixty seconds slow." To test a watch for this error, set it on time by a regulator, noting its rate lying dial up for twenty-four hours. Then place it nine o'clock up for twelve hours and three o'clock up for twelve hours, and the sum of these two last positions will be its rate for the short arcs, while the first twenty-four hours' run will give its rate for the long arcs.

Pattern for Saddle-shaped Boiler.—A pattern for a saddle-shaped cast-iron boiler made as follows will answer for moulding in green sand. Prepare two substantial blocks A (Fig. 1) made to the inner contour of the casting. To these blocks nail or screw two pieces B and a piece C, all the pieces being made



Pattern for Saddle-shaped Boiler.

to the thickness of the metal; C should be saw-kerfed, so that it will bend to the required curve. On each end of B and C fasten D, and two strips E, running the whole length of the pattern. Finally attach F by screws, which may be released to facilitate removal of the core, which is rammed inside the pattern. The pieces F should be stiffened by removable battens to prevent the ramming bulging the pieces outward. The open part of the core is strickled to shape by a straight strip of wood G (Fig. 2) shouldered down to the thickness of the metal, and guided by and working between the two segments D (Fig. 1). When the mould is to be rammed, the battens used for stiffening the pieces F (Fig. 1) are removed. The inside of the pattern is then filled with sand and strickled off level with the convex edges of the segments. The latter is done with the flush edge of the strickle G (Fig. 2). After withdrawing the pattern, the stiffening blocks A (Fig. 1) are stopped off by filling up the spaces left by them in the sand. The core must be supported in the mould by studs or chaplets, and provision must be made for securing the vent of the core through branches or openings on the casting. Any branch on the casting not occurring at the junction of the straight and curved parts of the metal should be left loose, so that it may be taken away on a draw-back plate. Shallow bosses or facings should also be loose. All external edges of the casting should be well rounded. Fig. 3 shows the finished pattern.

Coloured Cement Floor. — In making a coloured cement floor 2 parts of Portland cement by measure are mixed with 3 parts of sand. Before adding the water, mix with it a little red oxide of iron. The exact quantity of oxide to use will depend on the depth of colour required, and must be found by experiment.

Particulars of Canada Balsam.—Canada balsam is a sticky, yellowish-white material, with an odour somewhat resembling turpentine. It is a crude turpentine, obtained by puncturing pine trees (Pinus canariensis), and is similar to the other forms of crude turpentine obtained from Pinus sylvestris and Pinus maritima. On heating it, the volatile portion passes off, leaving a hard resin which is used as a waterproof cement for glass, etc., and for mounting specimens for the microscope; for the latter purpose it is dissolved in chloroform.

Brush for Enamel Paint.—A hog's-hair lather brush for which a barber has no further use is best for applying enamel paint. Having been constantly in hot water, the bristles are split fine so that no hair marks will be left when applying the enamel. Neither mops nor fitches are of any use for the purpose: the latter are employed in general painting for touching up, filling in, cutting in, and lining. A fitch can be softened in hot water.

Setting-out the Bevel of a Hip Rafter.—Below is given a method of finding backing to hips. Set out to scale the line of the pitch of the roof as shown at A B C (Fig. 1), and a portion of the plan D E F G; E G will be the plan of the hip. At right angles to E G set up G H, making it the same length as the height B C, then

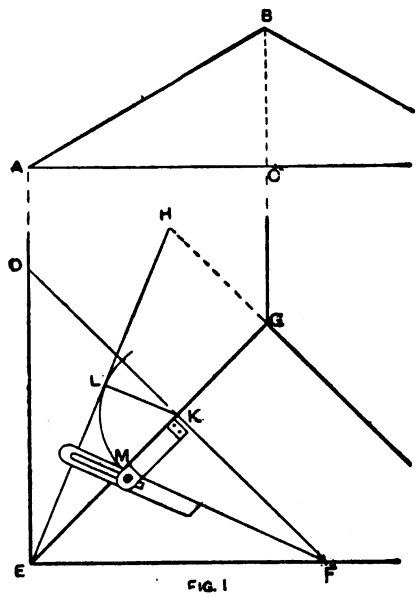


FIG. 1

E H is the pitch of the hip. In E G take any point, as K, and at right angles to this line draw D F through K. With K as centre draw the arc L M tangent to E H as shown, join M F, which is the angle of the backing. Set the bevel to the drawing as shown. Fig. 2 is a sketch showing the bevel being applied to the hip. A drawing as shown at Fig. 1 can be sketched on a board to about 1 in. scale on a building, and it will be found to take up much less time than the rule-of-thumb method of guess and trial. If work is to be done properly and without mistakes, time must be allowed to set it out. There is no other proper way.

Re-tinning Copper Vessels.—The object of tinning copper stewpans is to prevent chemical action on the copper, which may be injurious to health. It also gives a much better appearance to copper cooking utensils, besides facilitating their being kept clean. To ensure success in re-tinning, the article must be perfectly free from grease or dirt—in fact, it must be chemically clean. For this purpose, first burn off all grease and dirt over a forge fire or with a blow-pipe until the article is heated to a dull red colour, being particular where the handles are riveted on. Now wipe out the inside with a small pad of tow, and set down to cool, and when cold, thoroughly scour the inside with wet rough sand or powdered coke until it becomes clean and bright. If the dirt has eaten into the metal, or if the surface is very black, wash it with raw spirit of salts (hydrochloric acid), using a piece of tow tied to the end of a short stick. Rinse with cold water, and then scour bright. When perfectly bright, wash the article well with cold water, taking care that no grit or sand remains inside, and then dust the inside with powdered sal-ammoniac. The outside must be prepared by coating it with a mixture of salt and whiting, which should be of the consistency of cream; this prevents any tin adhering to the outside. If the top of the outside requires to be tinned to the depth of about 1 in., as is the case with all new stewpans, it should be thoroughly cleaned as before explained. A band of tin 1 in. deep should be tightly held round the top of the stewpan, while the mixture of salt and whiting is rubbed over the stewpan below the band. Now remove the band, and dust the bright surface of the stewpan, formerly covered with the tin band, with sal-ammoniac. A rubber, by which the molten tin is manipulated over the copper surface, is made as follows. Coil the end of a piece of ¼-in. wire, about 18 in. long, until it is about 2 in. in diameter, and tin the coil by soaking it in raw spirit of salts for some time, and then dipping it in a saturated solution of sal-ammoniac and killed spirit (chloride of zinc), and rubbing whilst hot on block tin or tinman's solder. Place the stewpan over a forge fire, and in it drop a small quantity of pure block tin; the amount of tin depends on the size of the vessel. The tin will soon melt, after which it must be rubbed over the copper with the rubber until the surface of the copper alloys with the tin. Any difficulty in getting this result may be overcome by repeatedly and alternately dusting with powdered sal-ammoniac and vigorously rubbing over the tin with the rubber. The top of the outside of the pan may be more easily tinned with a soldering iron, the solution of sal-ammoniac and chloride of zinc being used instead of the powdered

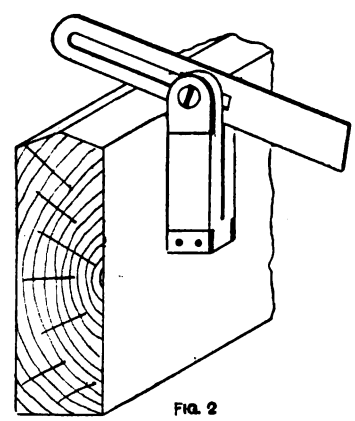


FIG. 2

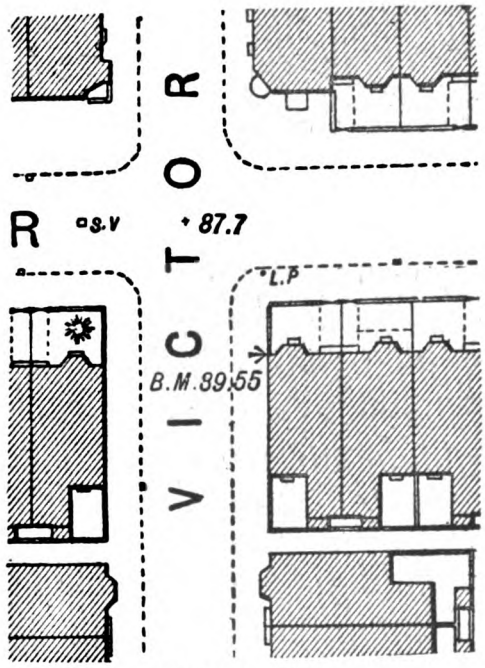
Setting-out the Bevel of a Hip Rafter.

sal-ammoniac. Care should be taken that the article is not allowed to get too hot. The maximum heat is obtained when the molten tin can be rinsed round the inside of the article. The molten tin is then quickly emptied out into another pan, if more than one is to be tinned, and the pan quickly wiped out with a pad of clean tow, which will remove any superfluous tin, after which it must be suddenly plunged into a vessel of cold clean water, and then dried by rubbing with clean hot sawdust. When pouring molten tin from one pan into another, great care should be taken in seeing that the pan into which it is to be poured is perfectly dry and warm, otherwise the possibility of the tin flying will make the operation highly dangerous. If a stewpan, ladle, spoon, or strainer requires to be tinned all over inside and out, it should be thoroughly cleaned, and the inside and outside should then be treated with saturated solution of sal-ammoniac and killed spirit of salts, and then dusted over with powdered sal-ammoniac. A vessel containing molten tin should now be in readiness, into which the article should be carefully plunged and washed. The article is then wiped with tow, plunged in cold clean water, dried with hot sawdust, and polished with whiting.

Developing Negative Films.—Nothing will prevent films curling during development, unless some mechanical means of keeping flat the film is adopted. A very good plan, however, with small films such as those of pocket kodaks is to roll the film, with the sensitised side outwards, round a bottle, the film being held in place with circular rubber bands; the bottle is then revolved in a deep dish well filled with developing solution. Such treatment does not of course permit errors of exposure to be corrected during development. Special frames are made for printing from films, but ordinary frames can be used, the film being laid on glass.

Painting Cardboard for Slate Pencil Writing.—The composition for painting cardboard so as to produce a surface that can be written on with slate pencil is similar to that used for blackboards. Four ounces of shellac should be dissolved in 1 qt. of methylated spirit, and then ground with 1½ oz. of flour emery, 2 oz. of ivory black, and 1 oz. of ultramarine blue. Other blackboard dressings are given on p. 230. Before using, the solution should be thoroughly shaken: a little is then poured out into a dish and evenly applied with a brush. Two or more coats will be required. If the cardboard is very porous, a coat of very thin size may first be applied.

Ordnance Datum.—The Ordnance datum is an imaginary horizontal plane extending over the whole country at the same height as the average mean level of the sea at Liverpool. This datum was fixed by the surveyors of the Ordnance Department, and the levels of districts are marked on the Ordnance maps as being so many feet above the Ordnance datum, that is, above the average sea-level at Liverpool. The accompanying illustration shows a small portion of the $\frac{1}{2500}$ Ordnance



Ordnance Datum.

map. At the corner of the house a bench-mark has been cut (these are usually about 1 ft. 6 in. above the surface of the ground), and the figures indicate that the point is at a height of 89·55 ft. above Ordnance datum. The figure in the roadway indicates that the road at that point is about 87·7 ft. above the datum, the second place of decimals not being given.

Polishing Brass Tube.—Brass tubes are prepared for polishing by being floated with a file, the teeth of which act as cutters and take off the top skin of the metal. Instead of floating, the tubes may be polished by grinding with an emery wheel of about 150 fineness. This wheel, 12 in. in diameter, is fixed on the end of the polishing spindle by means of a false nose, the wheel being held in place by a nut screwed tight on the end of the thread of the spindle. On the bench is fixed a large compound slide-rest with an arrangement to carry the tube; a table is placed both in front and at back of the slide-rest to prevent the tube bobbing about. The advantage of the slide-rest is that any size of tube from ¾ in. to 2 in. may be ground by simply raising or lowering the tool-holder and the tube carrier. The tube is placed on the carrier and adjusted till there is the slightest pressure or allowance for grinding by the wheel. The side of the wheel, not the edge, is used to grind with, and the tube is passed between the rest and the wheel, which takes off from the tube, with a circular motion, the thinnest possible amount of brass. Each side is served in this manner. Tubes are ground much more quickly by this method than by hand floating. After grinding, the tubes are treated with ordinary polishing sand and finally finished off with the ordinary cotton mop and compo. The mops should be closely sewn together, the rows of stitching being about ¾ in. apart. They are further strengthened by bolting together with four ordinary snap-head, square-shank ¼-in. diameter iron pins with nuts.

Cleaning Paraffin Barrel.—Paraffin oil cannot be removed from the pores of a wooden barrel by chemical means. If the barrel is to be used for storing water, the oil could be removed by knocking out one end of the barrel and placing some lighted shavings in the barrel. After the oil has been burnt out the barrel may be covered with boards and earth until the flame has disappeared. The charcoal formed by the partial burning of the wood in the interior of the barrel will be an advantage rather than otherwise in a water-butt. The only alternative plan is to take one end out of the barrel and leave it in the open air until all the paraffin oil has evaporated, then give the inside of the barrel a coat of slaked lime, thinned to a cream with water. This will take longer, but will be safer than the first method.

Gramophone or Phonograph Motor.—Ordinary brass clock wheels will do for a clockwork gramophone or phonograph motor. The motive power can be the mainspring and main-wheel complete of an eight-day American

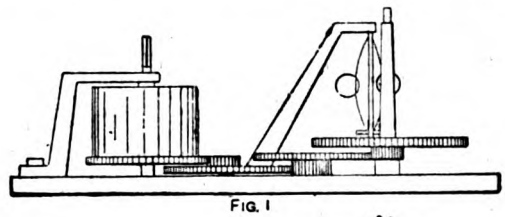


FIG. 1

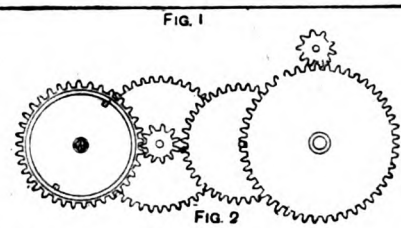


FIG. 2

Clockwork Motor for Gramophone or Phonograph.

clock, but a stronger wheel would wear better. The train consists of three wheels and pinions (see Figs. 1 and 2), and each wheel and pinion has a ratio of about 6 to 1. They are controlled by a weight governor like a steam-engine governor. The last wheel of the train carries the discs and drives the governor. The wheels are mounted on studs on a bedplate, as in Fig. 1. The last one, carrying the discs, has a long "pipe."

Recipe for Iron Cement.—Iron cement, used for filling up cracks and blowholes in iron castings by application with a hot iron, may be made as follows. Take by weight 2 parts of sulphur and 1 part of fine blacklead. Place the sulphur in an old iron bowl and hold over a fire till the sulphur begins to melt; then add the blacklead, and stir till all is well mixed and melted. Then pour on an iron slab or smooth stone. To use the composition, a sufficient quantity is broken up, placed in the hole, and soldered in by means of a hot iron, in the same manner as a tinsmith solders sheets. As the fumes of sulphur are very annoying, the material must be melted in a good draught.

Cork Paint for Ships.—"Cork" paint, sometimes used on ships' ironwork to prevent it rusting, is composed principally of white lead, oil, varnish, and quick driers. After the surface to be treated has been scraped and red leaded, the paint is applied, and granulated cork is thrown on to the wet surface; when thoroughly set, the cork is painted over. This method is only adopted where the space is to be utilised for sleeping accommodation, and where the iron is not specified to be covered with wood. This method is rarely employed in the merchant service, but in cruisers, where as little wood as possible is used, cork is freely made use of, being generally mixed up in the paint shop of the yard where the work is done.

Replacing Jewel Hole in Geneva Watch.—The jewel hole in the balance of a Geneva watch is held in position by the thin edge of its setting being burnished over the edge of the jewel. In fitting a new jewel hole, the old one must be pushed out by a flat-pointed peg, and the edge of the setting raised by very carefully running the smooth point of a centre-punch round it. After fitting the new hole, which should go tightly into its recess, the thin edge must be once more burnished over the edge of the stone by running the centre-punch point round it, using a little oil as a lubricant.

Fire-cracks in Plaster Walls.—Fire-cracks (which in some parts of England are called air-cracks) in plaster walls should be treated before giving the primary coat of paint with a coat of weak glue size (½ lb. best Scotch glue to 1 gal. water) applied when the size is quite hot. About 1 sq. yd. should be done at a time, and the size should be wiped off at once with a piece of old rag, the object being merely to fill all the small cracks with size. The surface of the plaster should be carefully wiped, for size should never be used on a plaster surface except for the purpose of filling cracks.

Furnace for Wagon Springs.—Fig. 1 is a cross section and Fig. 2 a longitudinal section of a suitable furnace to be used when making railway wagon springs. A shows the firehole, B the blast inlets, and C the chambers for the spring plates. The products of combustion pass through flues in the bottom of the third chamber, and thence under the floor to a stack in some convenient position. The furnace should be built of brick and lined with firebrick, iron doors being fitted in the usual manner to open with chains, pulleys, and weights or levers. The stays are of cast iron.

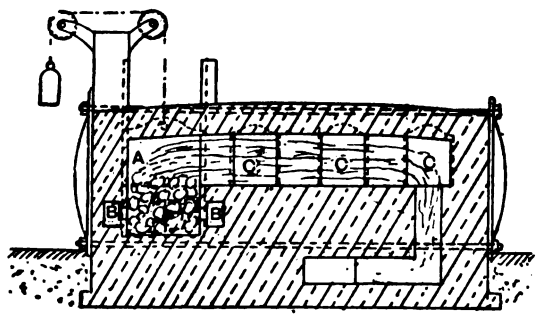


FIG. 1

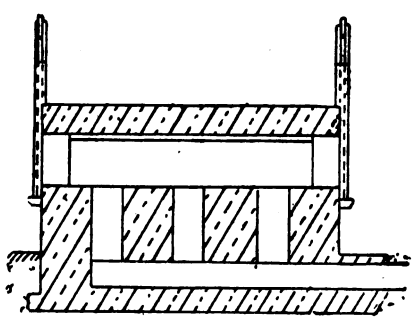


FIG. 2

Furnace for Wagon Springs.

Preserving the Colour of Bath Stone.—Repeatedly cleaning off the face of Bath or other stone by rubbing, glasspapering, etc., is to be deprecated, as it removes the natural skin, and, by opening the pores of the stone, makes it absorbent. Treatment with Fluate or the Szerelmey liquid will give the surface of the stone a siliceous skin, closing the pores, and making the stone non-absorbent. Neither of these preservatives will appreciably alter the colour of the stone, although it is probable that in time the stone will become a little darker. An alternative plan is to paint the stone with a flatting coat of white lead mixed with turps and a very little linseed oil; this leaves a dead surface without gloss and not unlike that of distemper, and is also a preservative.

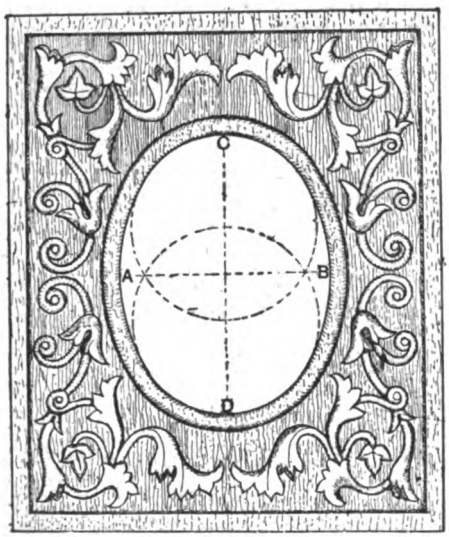
Re-painting and Re-lacquering Bedstead.—In re-painting and re-lacquering a half-tester bedstead it is necessary that first the brass headrail and footrail be taken to pieces. Thoroughly clean off the whole of the old paint with a shavehook or other tool, then rub down the iron perfectly smooth. Mix a quantity of one of the following mixtures: (1) Ivory black and shellac varnish. (2) Melt ¼ lb. of asphaltum, and add 1 lb. of hot balsam of copaiba, and when mixed thin down with hot oil of turpentine. (3) Grind ivory black very smooth with turps on a marble slab with a muller, and add copal varnish till the paint is of the proper consistency; sufficient varnish only must be used to cause the colours to bind and dry firm and work free without becoming either sticky or shiny. The ironwork must then be carefully painted with the varnish by means of a camel-hair brush. About three to five coats must be given, each coat being dried in an oven heated to about 300° F., and if possible the heat must be gradually increased, but not to such a point as will calcine the paint. When sufficient body has been laid on, the work will be ready for polishing; this is done in most cases by rubbing down with a piece of felt dipped in tripoli or very finely powdered pumice-stone. Towards the end of the rubbing add a little oil, and when the work appears bright and glossy rub with oil only. Care must be taken that there is no grit in the polishing medium, or the work will be scratched all over and spoilt. Finish off with a soft cotton or silk duster. The brass part of the bedstead must be boiled for about twenty minutes in a strong solution of soda or potash—say ½ lb. of potash and 1 gal. of water; then well wash in clean cold water and dry. If the old lacquer has been removed, dip the parts in aquafortis by means of brass tongs; when quite bright and clean, plunge in clean cold water, and dry in warm sawdust. The re-lacquering may then be done. It will be better to obtain the lacquer ready made. It must be applied with a large flat camel-hair brush, and the pieces of tubing laid on a hot stove or in an oven to set the lacquer. The various parts of the rails may now be put together, and the bedstead set up again.

Burnt Ballast for Mortar.—Where clean sharp sand cannot be had, burnt clay ballast or coke breeze are very good substitutes. Coal slack is not to be recommended. The coke breeze should be obtained from the nearest gasworks. The burnt ballast may be prepared in the following manner, the object being to burn the clay hard, as in brickmaking. Four or five old drain pipes, 9 in. or 12 in. diameter, are laid in line with open joints. Around one end of the flue so formed is placed a heap of wood, say 3 ft. high and 6 ft. across the base. Over this conical shaped heap of wood is spread a good layer of coal, and on the coal a layer of clay 6 in. or 8 in. thick may be deposited. Before attempting to burn the clay, it should be well turned over, and tempered and dried in the air. When the fire is burning fairly well, more coal or breeze is added, and, when everything is red hot, another layer of clay. More coal and more clay are in this manner added to the heap, until it becomes so large that further additions to it cannot conveniently be made. The fire is then allowed to die down, and the ballast is broken up and taken to the mortar mill. One cubic yard of clay measured in the solid, before digging, will, when burnt and broken up, make 1¼ cub. yd. to 1½ cub. yd., and will weigh about 1 ton. From ¾ cwt. to 1 cwt. of coal is required to burn 1 cub. yd. of clay; or, according to some authorities, about 11 cub. yd. of breeze and 4 tons of coal, including slack, will burn 10 cub. yd. of clay.

Taking Soundings of Ship's Well.—On each side of a ship's keelson there are "limber holes," which allow the bilge water to pass freely to the lowest part of the compartment, where there is an iron perforated casing to keep out rust chips or other sediment that would prevent correct soundings. These casings are about 15 in. in diameter, and one is fitted alongside the keelson in each compartment at the lowest point (which is aft in the fore-body compartments and forward in those of the after-body). Any leakage or cargo sweat is free to run down the skin between the frame or ribs to the limbers. The sounding tool is an iron rod 2 ft. or 2 ft. 6 in. long, attached to a small line. The ship's carpenter chalks this rod and drops it into the casing or well (keeping it vertical, of course). The well soundings are entered in the log book in inches twice daily. The iron rod is notched with a file at every inch. Some steamers with several compartments have limber holes in some of these which can be immediately closed, in case of collision, etc., by a screw sluice door manipulated from the main deck.

Removing Cannon Pinion from Keyless Watch.—In removing from a keyless watch a cannon pinion that is fixed very tightly, if there is a square at the back take hold of it with a pair of cutting nippers in one hand and grasp the body of the cannon pinion with a pair of brass-nosed pliers held in the other hand, and twist the pinion off. If it cannot be removed in this manner, or if there is no square at the back to hold, the centre arbor must be punched through with a small-pointed punch that will just enter the cannon pinion without damaging it. The watch should rest on a stake or piece of boxwood with a hole in it under the centre arbor. One smart tap should send the centre arbor through.

Design for a Carved Photo Frame.—Walnut, oak, or canary wood is suitable for constructing the photograph frame here illustrated. It should be about ¾ in. or 1 in. thick, and 10½ in. long by 9 in. wide. The outside margin is ⅝ in.; the size of the inner oval, from A to B, 4½ in.; from C to D 5¼ in.; and the outer oval is ⅝ in. larger all round. The oval could be made larger or smaller, to suit the photo; the dotted lines show the method of construction. The design is simple and plain, and easy to mark on the wood. If the lines A B and C D are continued to the outer edges of the wood, they will divide it into four

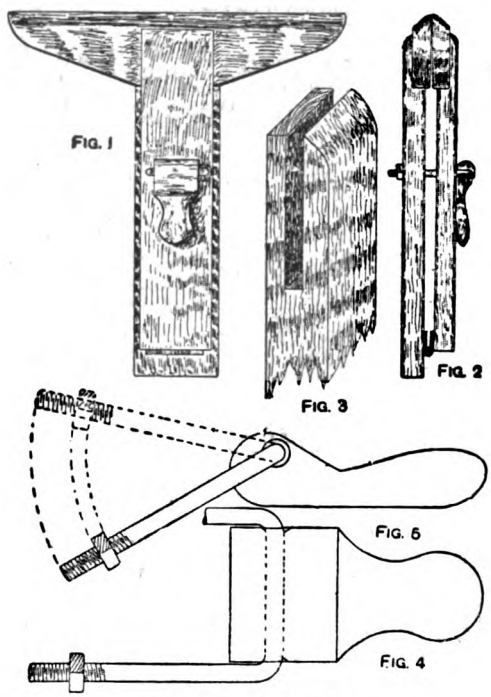


Design for a Carved Photo Frame.

equal parts, and if one part of the design is sketched and taken off on tracing paper, it can be applied to each corner. The ground can be punched or cleaned.

Brazing Brass and Iron.—A brazing spelter for small articles of brass consists of 5 parts copper, 3 parts zinc, and 2 parts silver, alloyed as explained on p. 63. If the seams are not required to stand much working after soldering, they may be joined edge to edge. When seams are formed in this way, little nicks, about ⅛ in. apart, should be filed out along the edges, so that the solder flowing through the nicks during the soldering operation will render the joint sound. If the seam is to be worked after soldering, a small lap is necessary to ensure adequate strength. To form seams of this type, first thin the edge of the metal along the ends that are to form the seams, about ⅛ in. in from the edge, so that when the two edges are lapped over each other the combined thickness at the seams will be the same as the single thickness of the metal at other parts. Cut a small cramp at the top and bottom of the seam, and fit the opposite edge in these cramps. After preparing the seams by either of the above methods, fasten binding wire round the articles so as to hold the seams securely in position. Now powder some borax for use as a flux, and soak it in enough water to form a thick paste; place a little of this along the parts to be soldered, and gently heat the article by some suitable means, such as foot bellows and blowpipe, so that it will expand equally, and not disarrange the seam; increase the temperature until the metal is a dull red, and then take a strip of the solder, dip the end in the borax, and, holding the opposite end with the pliers, rub the solder along the seam until a little melts off. Keep the solder in a molten state, and with a piece of wire flattened at one end gently rub the solder along the seam until every part is joined. Small articles of iron may be joined in a similar way with equal parts of copper and zinc, but if the iron is to be hammered much after soldering, 2 parts of copper and 1 part of zinc would be more suitable. With these solders mix equal parts of the borax paste and grains of solder, and along the seams place sufficient of the mixture to solder them when melted. Some dry borax should also be kept ready at hand, so that a little may be taken and thrown on the solder at any point where the material does not appear to be flowing freely.

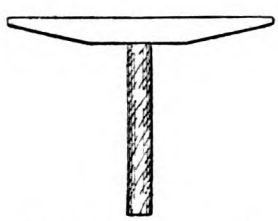
An Improved Saw-vice.—Figs. 1 and 2 show an ordinary pattern of joiners' saw-vice, differing from others only in the method of tightening up the jaws; Fig. 3 shows the bare-faced tenon for uprights, and Figs. 4 and 5 plan and elevation of eccentric clamp with rod and nuts. The rod is of ½-in. round iron, with thread each end (mild steel would be more suitable), the bends being made by heating the iron red hot for the first, and nearly so when placed through the hole in the clamp and bent. This clamp must be shaped out, and the part where it will tighten on the stock by revolving should be smooth and true. Two ⅝-in holes, which will be 6½ in. down, are bored through both uprights to accommodate the ends of the rod, and collars may be let in flush at the back to tighten the nuts against. When the nuts are adjusted, a saw is instantly clamped by pressing the handle down as shown in Figs. 1 and 2. To release the saw, pull the handle of the eccentric clamp (lever) up. The position of the rod hole is as shown on the handle side of the circle, and farthest from the stock. It will add to the grip to make uprights slightly curved outwards in the middle, and a 2½-in. butt hinge will complete the vice. A strip of vulcanised rubber or leather fastened along the inside edge (top) of jaws will improve the filing.



An Improved Saw-vice.

Cutting Tin-plate.—If a number of pieces of tin-plate the same size and form are to be cut, it is usual to have a punch and die cut to the desired shape; these are fitted to a press, and the pieces are then stamped out. If a limited number only is required, or if the pieces differ in size and shape, a circular hole smaller than the opening required is punched out with a hollow punch upon a lead piece; the nose of a pair of circular snips is then inserted through the hole and the metal cut away to form an opening of the shape desired.

Laying Marble Mosaic Pavement.—The materials commonly used for marble mosaic paving are known as burnt marbles—that is, pure marbles burnt to the desired colours, such as rouge royal (red) and Russe cotto (red), with yellows, blues, greens, and greys of various shades, according to the amount of time spent in burning. The natural marbles used in their original form are chiefly St. Ann's marble and Carrara and Irish green. The cubes may measure about ⅝ in. square, though the size of the cubes depends on the area of the floor to be covered; but the cubes generally used are from ½ in. to ⅝ in. square, and are either sawn or cut by hand to the required dimensions. For each floor only one size of cube is used. The tesseræ are fixed with a cementing material consisting of chalk lime slaked with water, and left in the open air for several days until it is killed; it is then sifted and mixed with a large proportion of fine crushed brick and water, and well beaten up with wooden beaters into a fine mellowed mortar ready for immediate use. The floor for the reception of the mosaic is generally formed of Portland cement concrete, floated over to a fairly true face; the mortar is now spread evenly on the floor, and the cubes of marble are laid to the required pattern, a small hammer being used for tapping the cubes in until they are solidly bedded. The floor is afterwards rolled with a moderately heavy roller, and then left for a time until the tesseræ are set, when the inequalities on the surface of the floor are rubbed off with specially constructed rubbers of sharp grit stone, water being freely used in the process. The face of the floor is rubbed very fine and left quite smooth, and finally finished off with linen rubbers. But a method very generally followed is to arrange the cubes on paper in the workshop, the first step in carrying out the work being to get out a design for the floor. From this design copies are made at full-size scale, usually on brown paper, ready for the workmen. Great care must be taken to ascertain that the whole of the design is reversed on the brown paper, as, the cubes being laid on the paper in the workshop, the paper would be uppermost on the job, and if the design were not reversed it would show the wrong way. The workman's paper, when finished, is cut up into convenient lengths (about 3 ft. 6 in.), marked with numbers from 1 consecutively, and handed over to the shop workmen, who require the following tools. A scabbling hammer (see illustration), about 11 in. long and 1 in. square, tapered each end and fitted to a short handle, a pair of callipers, an iron block about 9 in. long by 4 in. by 4 in., granite rollers, straightedges, and rubbers. The workman now proceeds to pick out the necessary colours of cubes, dresses the cubes with the scabbling hammer to suit the design, and covers a portion of the design with a layer of gum, to which he attaches the cubes, doing small portions at a time until the whole is completed. The design having been completed by the shop workmen, the whole is forwarded to the scene of the job. The mosaic layer is given a plan of the floor marked with numbers corresponding to those marked on the mosaic paper. Having laid the paving out on the job, the mosaic layer next prepares the cement, to which he fixes the marble slabs. After two or more days, the cement having become set, the paper is cleared off, and the whole of the paving is subjected to considerable rubbing with fine grit stone, attached to a wood handle having a V-groove. The paving is completed by being rubbed to a level.



Scabbling Hammer for Laying Marble Mosaic.

Bronzing Brass Brackets.—Fancy brass brackets, such as gas brackets, are usually only dipped in a nitric acid bath and burnished. If the dipping does not give the desired brightness, the brackets are dipped again and again, and thoroughly washed and dried between each dipping. If the finish is not then suitable, the brackets may be dead dipped: this gives a dead yellow surface, and after the prominent parts are burnished presents a very artistic appearance. To dead dip, after well pickling the articles, place in stronger nitric acid till a frothy appearance results; then wash in water and dip for a few seconds in the strongest nitric acid. Wash in a bath containing a little dissolved argol or cream of tartar, and dry in warm sawdust; then burnish the articles and lacquer in clear lacquer. A different but equally pleasing appearance may be given to the brackets by bronzing. A bath that imparts to brass a shade from brown to a deep red can be made by dissolving 2 oz. of nitrate of iron and 2 oz. of hyposulphite of soda in 1 pt. of water. Immerse the articles in this till they are of the required tint. For a shade from a pale green to a deep olive green, add 1 part of perchloride of iron to 2 parts of water. For a dark green tint take 1 pt. of water, 1 oz. of nitric acid, and 4 oz. of nitrate of copper. A bronze which gives a very good finish is composed of 1 part oxide of iron, 1 part white arsenic, and 12 parts hydrochloric acid. All grease must first be removed from the articles and the bronze painted on with a brush. When dry the articles may be burnished in the usual way in part, or plain lacquered with a clear lacquer, or they may be plain varnished, according to taste.

How to Make a Chemical Tank for a Magic Lantern.—The following are instructions on making a small chemical tank for magic lantern experiments. Procure three glass plates 3¼ in. by 4¼ in. From one of these plates a half-circle must be cut out with a diamond, using a half-circle of wood as a guide. Canada balsam is used as the cement. It must be placed in a saucer and baked in the oven until it is quite hard when cold. The three pieces of glass should now be heated in the oven or on an iron plate placed over a burner until they are too hot to be touched by the hand. The melted Canada balsam must now be spread with a smooth stick on both sides of the glass plate from which the half-circle has been cut, the other plates being pressed one on each side of it to remove all air bubbles. The whole should then be placed under a weight till cold. The tank thus made will appear like Fig. 1, and may be placed in an ordinary carrier. With a lantern suitable for experiments requiring a wider tank two 4½-in. by 4¼-in. plates may be used, cementing them together as described above by three pieces of plate glass, the bottom piece 4¼ in. by ¾ in. and the two side pieces each 3¼ in. by ¾ in. to form a rectangular tank 3¼ in. by 2¾ in. by about ¾ in. deep (see Fig. 2). These measurements may be altered if necessary to suit the lantern.

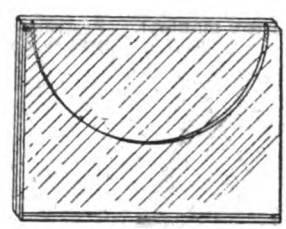


Fig. 1

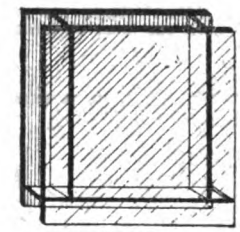


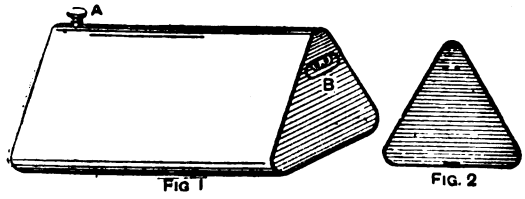
Fig. 2

Chemical Tank for Magic Lantern.

Remedying Pinholes in Photographic Negatives.—Ordinary water colours are best for stopping pinholes in negatives. Almost any colour will do; but the work is more easily and better done when a colour that matches the tint of the negative is used, such as ivory black. The colour should be applied with a good sable brush, No. 2 being the best size. Rub a little of the paint on the smooth side of a piece of opal or even a piece of glass, and take up a little colour with the brush, drawing it with a circular motion to a fine point. If the brush is too wet the paint will run round the spot, and not in it. A white ring round a black spot only makes the spot more noticeable on a print. With the top of the brush touch the exact centre of the spot slowly but very delicately. In some few cases where the film has disappeared it is impossible to remove all traces of the spot; and in such cases it is advisable to fill in the spot densely on the negative, and paint over the white spot on the print. Exceedingly small pinholes, sometimes met with in clusters, are best left alone. A black spot on a print is less noticeable than a white one. Spots are usually the result of dusty slides or camera or dark room, the dust being finally deposited on the face of the plate. Soaking a plate in water before developing is liable with some plates to cause pinholes, the minute air balls that then form on the surface of the plate preventing the action of the developer.

Finishing Stair Balusters Green and Bronze.—Some stair balusters are to be painted two coats, finishing green and bronze. The first coat should be lead-colour paint, and when this is dry give a coat of bronze green made from drop black (about one-third) and yellow ochre (about two-thirds). Thin with benzoline, adding a few drops of terebine as a drier. Put the bronze in a pint pot, cover it well with turpentine (which will extract the verdigris), and let it stand for six or seven hours, after which the turpentine should be thrown away and fresh turpentine added. Varnish the balusters, and when the varnish is nearly dry dip a piece of plush velvet in the bronze, and apply to the projecting points of the balusters. This should be done while the varnish is tacky, so that the bronze may dry with the varnish.

Making Copper Foot-warmer.—To make a foot-warmer, cut a piece of No. 22 or No. 24 sheet copper to 22 in. long by 12 in. wide. Scour it thoroughly with wet sand, and tin one side of it over a coke fire with block tin, using sal-ammoniac as a flux. When the tin has alloyed itself with the surface of the copper, wipe off with a pad of tow, and immediately immerse it in clean cold water, afterwards cleaning with silver sand, and then drying with hot sawdust. Punch a hole for a feeder screw A (Fig. 1) in the centre of the length 1½ in. from the edge. The copper should now be planished with a planishing hammer on a tinsmith's bright anvil. This will close the "grain," thus increasing the durability, as well as developing a bright, smooth surface. Two edges opposite each other should now be set off the ends on a hatchet stake, so that when the copper is bent to shape the edges will clip each other. The bending can best be done over a narrow mandrel,



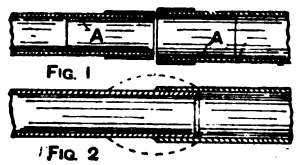
Making Copper Foot-warmer.

and the edges must be "grooved" inside. When this has been done the section will appear as in Fig. 2. Solder the feeder screw in the hole from the inside, and similarly the grooved joint, leaving a good body of metal on each. This constitutes the body of the foot-warmer. To make the ends, up-end the body on a piece of copper, and mark around. Allow a ¼-in. edge extra, cut the copper, and mark and cut out another one from it. These pieces should be cleaned, tinned, and planished, etc., as previously described. Then they should be slightly hollowed (both together) on a wooden block with a hollowing hammer. Now crease or "jenny" the edges so as to fit the body tightly. Before these pieces are finally fixed, two handles B (Fig. 1) must be made from No. 8 brass wire, each with a copper plate which is riveted to the end, as shown. Solder over the heads of the rivets inside, fit each end on, and solder well round. The superfluous solder may be removed by a steel scraper or a smooth file. Rub well with emery cloth, and finish with crocus and oil.

Particulars of Cellulose.—Cellulose is an organic product having the same composition as starch, and is a similar composition to sugar, i.e. $C_6H_{10}O_5$. The purest cellulose is sold by chemists, etc., as cotton-wool for medical purposes; the cotton fibres, linen, wood of all kinds, paper, etc., are all more or less impure forms of cellulose.

Buff Balling Bottoms of Boots.—To make out the bottom of a boot, the sole should be buffed or scraped with the buff knife, that has been well sharpened till it has a keen, regular edge. Only the first layer of grain is taken off the sole; when this has been carefully done and the sole has been well sandpapered, it should have a fine velvet-like surface. It is, however, very hard to produce in this way a white bottom upon bad leather, or upon good leather improperly worked. With a soft brush remove all the dust of leather made by this process, and scrape some buff ball all over the bottom, and with a fine piece of sandpaper work it evenly all over the sole, and then smooth it down with the back of the paper. With a clean soft piece of flannel, lightly damp down the whole of the sole, doing it evenly all over, so that the leather just changes its colour; then scrape some buff ball all over the sole while it is damp. Hold the boot firmly between the knees, and with a hare's foot or piece of soft flannel dab the buff ball down to cover the sole. Finish by brushing off any loose dust with the hare's foot.

Wiping Joints on Copper Pipes.—Wiped joints on copper pipes are longer than wiped joints on lead or composition pipes. Copper pipes 2 in. or more in diameter have joints from 2½ in. to 3 in. long; 4-in. pipes have joints about 4 in. long; but it must be remembered that whilst reasonable length and thickness of joint are necessary to enable the copper pipe to withstand pressure and strain, the maximum time of service does not depend on the length or thickness of the joint as in lead-pipe work. That which determines practically the life of the joint is the extent of pipe which is carefully tinned before forming the wiped joint. If the interiors of the two pipe ends are tinned, say, for 6 in. or 8 in., on cutting open the joint in a few years' time, it is found that the tinning has diminished to 2 in. or 3 in., a corroding action having taken place at the end of the tinning; for this reason it is advisable that the tinning be fairly thick, so as to retard the separation and ultimate failure of the joint. In tinning copper, first thoroughly clean it with dilute sulphuric acid or scour with sand and water, and then rinse it with chloride of zinc, known as killed spirit. Melt some pure tin, throw in sal-ammoniac as a flux, and dip the copper in the tin, or pour or rub the latter over the copper. In pipes forming a portion of a distillery plant it is especially important that no untinned spots are left on the interiors of the pipe ends, as at such spots the destruction of the tinning commences at once. In Fig. 1, which is a part sectional view of the two pipe ends pre-



Wiping Joints on Copper Pipes.

pared for jointing, A shows the extent of the tinning, which is on the exterior and interior of the pipe ends and on the edges also. Fig. 2 shows the tinned ends slipped together ready for wiping, the form of the required joint being shown by the dotted lines. The pipe is strengthened by putting one pipe within the other, and the corrosion of the tinning is arrested when it reaches the lap. If sufficient lap is given, the pipe may be handled before the joint is wiped—a great convenience. The pipe ends are placed together, when practicable, over the iron pot containing the molten solder, which is then poured continuously over the joint until a heat is got up. This practice is not possible with lead or brass pipes, because in the one case the lead would melt, and in the other the molten zinc would leave the brass and ruin the solder. When the pipes cannot be moved, a grain scoop (a kind of shovel) is placed beneath the joint and the solder poured on rapidly. When a thorough heat has been obtained, the joint can be wiped, with the aid of a cloth and of the mushy solder from the scoop, in much the same way as a joint on a lead pipe is wiped, the latter operation being described on p. 88.

Adjusting a Watch in Positions.—Provided there are no faults in the escapement, pivots, or jewel holes, the adjusting of a watch in positions is mainly a question of exact poise of the balance. The balance, with its pivots perfectly clean, should be placed on a poising tool and carefully tested. In a plain balance, filing the inside under edge of the rim will poise it. In a compensation balance, small errors can be altered by manipulating the four "quarter screws"—that is, those with long taps. Larger errors must be corrected by altering the weight of the screws. When perfectly poised, the watch will be very nearly correct in different positions. A loss in any one position generally indicates that when the movement is held in that position, and the balance is at rest, the top of the balance rim is too heavy.

Removing Ink Stains from Bone Handles.—To remove dirt from bone knife-handles scrub with hot soap and water, and wash well with clean water; rub on a solution of oxalic acid to remove ink stains. Again wash, dry, and polish with a chamois leather and whiting.

Traveller's Sample Case.—Figs. 1 to 5 show the construction of a traveller's sample case. Good red deal, birch, beech, or other similar hardwood, ¾ in. to 1 in. thick, may be used, according to strength and other requirements. The angles should be dovetailed together, and the boards jointed and cross-tongued, as shown at Fig. 4. To prevent dust, etc., getting in, a fillet about 1¼ in. by ¾ in. should be nailed round so as to project into the lid when closed (see Fig. 3). If the staples are made as shown at Fig. 5, they can be screwed to the front of the rim of the lid, and the returned piece shown at A (Fig. 5) can be let in and screwed to the underside of the lid; this will prevent it being broken off. The eye and plate can be made so that the eye passes through the front, the plate being screwed to the inside; it is thus not likely to be broken off or unscrewed from the outside. Two padlocks may be used, or a rod and one lock, as shown in the illustrations. For ordinary purposes, one staple, eye, and lock would be found sufficient.

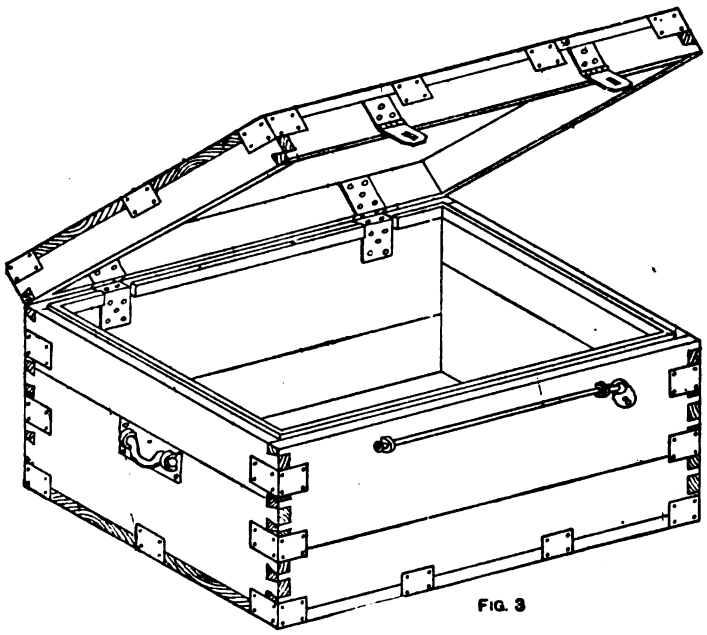


FIG. 3

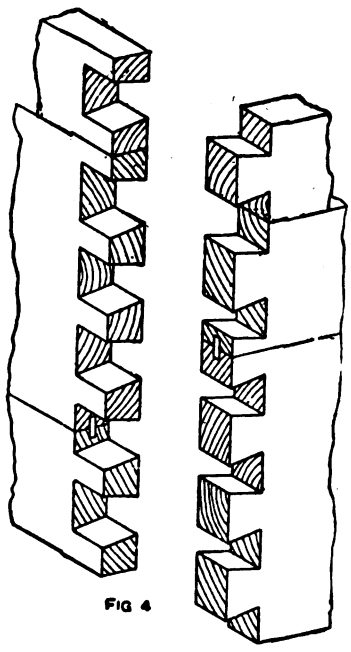


FIG 4

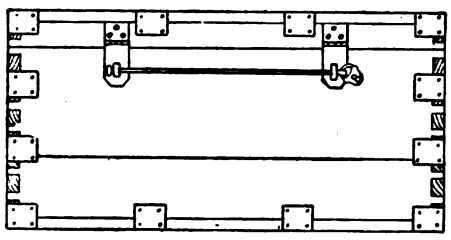


FIG. 1

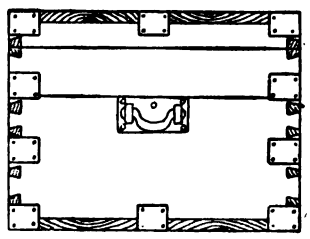


FIG. 2

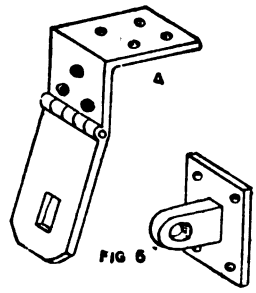


FIG 5

Traveller's Sample Case.

Lining a Wooden Tank with Lead.—In lining with lead a wooden tank 20 ft. by 9 ft. by 4 ft. deep, first divide the bottom of the tank into three parts. This gives two seams across the bottom, and where the seams come the woodwork should be dished for the soldering to be wiped flush. The lead for each end of the tank can be in one piece, and if plenty of help is available, the sides could also be each in one piece. But if the tank is in a cramped position where the extra hands cannot exert their full strength, each of the sides can be lined with two pieces, dishings being made in the woodwork for flush seams to be wiped upright in the centre of their length. For rain water, the sides and ends should be of 7-lb. lead, and the bottom of 8-lb. lead; but if economy must be studied, 6-lb. lead sides and ends, and 7-lb. lead bottom, would do. To line the tank, first put in the sides, then the ends, and the bottom last of all. After the lead is in position, the upright flush seams and the upright angles should be soldered, then the bottom flush seams, and lastly the bottom angles. It is assumed that sufficient knowledge is possessed to arrange the laps so that the solder will not run through when wiping, and also to prepare the work for soldering. Upright stiffening pieces wiped on to the sides are better than dots; but if it is found necessary to fix stay rods to keep the sides from bulging outwards, these rods would also help to support the lead, and prevent it from bagging as the tank is emptied of water.

Silver Solder for Soldering Copper.—A silver solder for soldering copper is composed of 5 parts of copper, 3 parts of zinc, and 2 parts of silver. Melt the copper first, then add the silver, and lastly the zinc; directly the zinc is immersed, rapidly stir the alloy so as to render its composition equal throughout, and then cast it in a small ingot mould. The ingot is then rolled down to form a small sheet equal to about No. 18 B.W.G. gauge in thickness, and from this narrow strips are cut as required. Ordinary solder may be converted into fine solder by melting and then adding the silver in the proportion given above.

Separating Gold from Ashes.—A simple way of separating gold from ashes is to mix the ashes with borax and melt down in a crucible. For this purpose the highest heat of a wind furnace will be required. If the ashes contain traces of other metals besides gold, it would be best to boil first with water several times to get rid of soluble matter, then with aqua regia (3 parts of strong hydrochloric acid to 1 part of strong nitric acid) in a porcelain dish, using a fume chamber or chimney to carry away the fumes. After boiling for several hours, water may be added and the liquid filtered. The filtrate will contain the gold and other metals as chloride. A solution of ferrous sulphate (green vitriol) should be added in excess, and the liquid boiled. A brown precipitate will come down; this is pure metallic gold. It may be filtered off, washed several times with water, and dried, when it will form a reddish-brown powder. It may be melted down in a crucible or in a furnace, or fused to a button of metal on charcoal before the blowpipe.

Waterproofing Fishing Lines.—Plaited silk fishing lines are waterproofed by soaking in equal parts of boiled linseed oil and copal varnish, then stretching in some convenient position to dry, at the same time wiping off superfluous dressing with a rag. Drying will take a considerable time; to accelerate it, 1 part of gold size may be used instead of the varnish to 2 parts of boiled oil.

Frame for Wire Blind.—Fig. 1 shows the general form of the frame for a wire window blind. Fig. 2 is an elevation of the joint (A, Fig. 1) to a larger scale. The tenon, mortise, haunch, and wedges are indicated by dotted lines. Fig. 3 shows the construction of the joint, mitreing of the head which is stuck on the solid, and the rebate formed for the movable bead, which is not shown. The beads should be about ½ in.

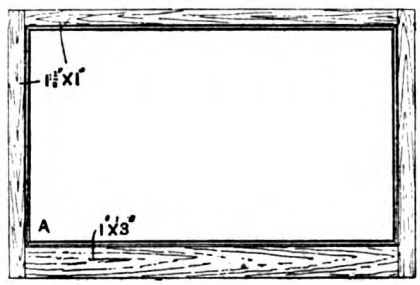


Fig. 1

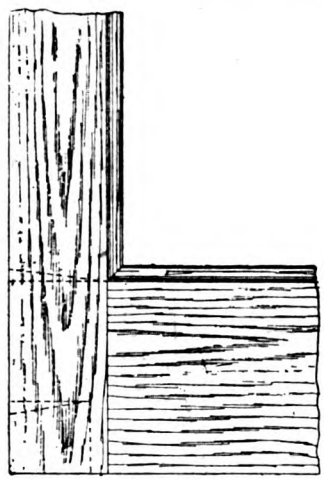
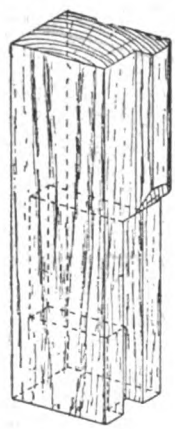


Fig. 2



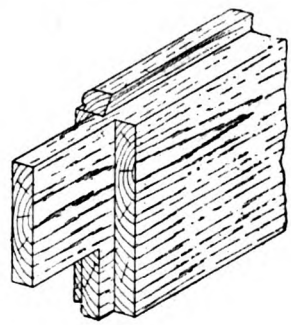


Fig. 3

Frame for Wire Blind.

Filtering Cycle Oil.—Dirty cycle or other machinery oil may be filtered through cotton-wool, flannel, or any similar material without affecting its lubricating properties. Flannel is not so good as closely packed cotton-wool, because the fibres are openly felted and the finer dirt can get through. Closely packed cotton-wool makes a slow filter. The best filtering arrangement is a glass or tin funnel placed in a bottle, and a circle of best white blotting paper folded twice and opened to fit the funnel. The oil will pass pretty quickly through the paper. When the blotting paper begins to plug up it may be removed and fresh paper substituted.

Wet-plate Photography.—In wet-plate photography the plates are prepared as they are required, and are developed immediately after exposure. Any camera may be used so long as provision is made in the dark slide to catch the drippings from the plates; a fold of blotting paper will answer this purpose. The following materials will be required for preparing and developing the plates. Mawson's iodised collodion 4 oz., silver nitrate 1 oz., a few pounds of hypo, alcohol 1 oz., acetic acid 1 oz., sulphate of iron 1 oz., an ebonite dipper, and some pieces of clean glass free from air bells. Make up the following solutions. *Silver bath.*—Silver nitrate 1 oz., distilled water 11 oz., iodine 1 gr., nitric acid 2 drops. *Developer.*—Sulphate of iron ½ oz., alcohol ½ oz., acetic acid ½ oz., water 4 oz. Clean the glass by first swilling with water, and, if greasy, washing with a powerful alkali such as caustic soda, and again swilling. Allow the glass to dry spontaneously. When dry, wipe free of dust, and pour in the centre of the plate a pool of the iodised collodion, as in varnishing a negative, and flow first to the top right-hand corner, next to top left-hand corner, then to the bottom left-hand corner, where the plate is balanced by the tip of the thumb and from the bottom right-hand corner pour off the excess into the bottle. As soon as the collodion has set (which is when the surface becomes dull) immerse the plate in the silver bath by means of the dipper, lowering gently into the solution, where it should remain, rocking occasionally, for about two minutes. As soon as the silver solution wets the plate evenly (this takes longer in cold weather) the plate is sensitised. The sensitising is done in the dark room, and a flat porcelain dish may be used to contain the bath. The plate is gently removed from the bath, and when it has finished dripping it is placed on the wires in the dark slide and exposed in the ordinary way, though for a longer time than a dry plate. The plate must be kept in a vertical position. On removal from the slide the plate is held in the hand, as in coating, and is flooded with the developer. Coating the plate, sensitising, exposing, and developing should follow each other as quickly as possible, or various defects will occur in the plate. As soon as development is complete the plate is immersed in hypo 1 oz., water 6 oz. The used developer and the drippings should be filtered through cotton-wool and saved for use in cases of over-exposure. Should the image be too weak, it may be strengthened or intensified by flooding with pyro 4 gr., water 2 oz., silver bath 1 dr., and 10 per cent. solution of ·880 ammonia a few drops. Wet plates may be varnished with ordinary negative varnish. The ferrotype is merely the wet collodion process for producing positive images on a metal, instead of glass, plate, the image being reversed as regards right and left. The only advantages of the wet collodion process are cheapness, extreme density and contrast in image, and fineness of grain. The process, being dirty and extremely slow, is now seldom used except by itinerant photographers.

Cementing Broken Marble.—As a cement for white marble, use fine plaster-of-Paris mixed to the consistency of thick cream. A thoroughly satisfactory job, however, cannot be made in the case of a mantelpiece, as the repair will show in time. For black or coloured marble use brown or orange lac, obtainable from dry-salters or chemists. Warm the broken pieces of marble before the fire, then place on the lac, and when melted press the two pieces together until firmly set—a few minutes will suffice; the superfluous lac should be squeezed out whilst it is warm. If desired, the lac may be prepared in sticks by melting it on a hot plate, adding the requisite colouring matter in the shape of oxides, and then rolling into sticks similar to sealing wax.

Tool Chest for a Light Coach Body Maker.—A tool chest suitable for a light coach body maker may be made of 1-in. sound red deal, free from knots and shakes and perfectly dry. The front and back should be jointed and glued in the centre as A (Fig. 1), the ends having two joints as B (Fig. 2), so that the strain is not on a direct line at the joints. The sides and ends should be dovetailed together, and should be 2 ft. 8½ in. long outside by 1 ft. 6 in. deep over all by 1 ft. 6 in. wide, the plinths being fixed outside this measure. The bottom is screwed on crossways of the length, and is tongued together as shown in Fig. 3. The top is made up lengthways of the grain, glued

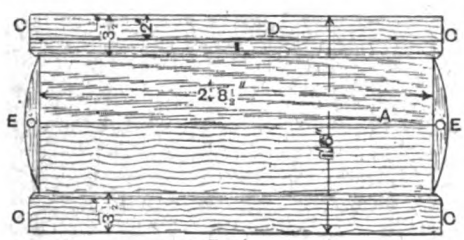


FIG. 1.

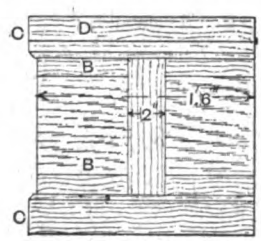


FIG. 2

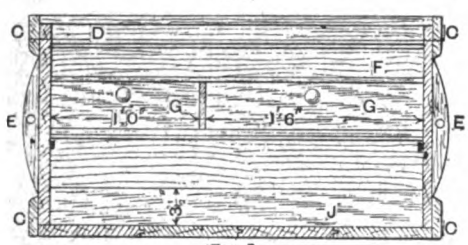


FIG. 3

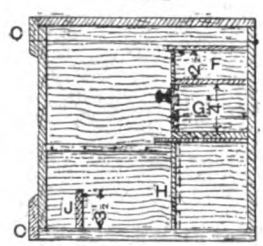
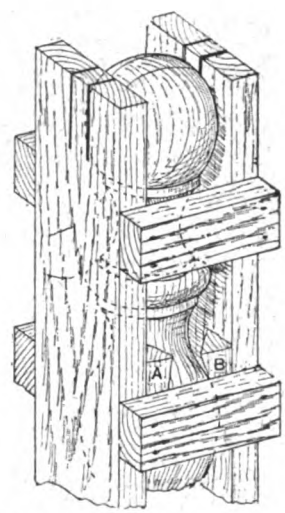


FIG. 4

Tool Chest for a Light Coach Body Maker.

Cutting Slot in Top of Turned Pillar.—When it is required to cut a slot in the top of a turned pillar, a box similar to the accompanying diagram should be constructed, and in each piece of board two kerfs



Cutting Slot in Top of Turned Pillar.

and jointed in the same manner as the front, and fixed on by screws. The whole is cleaned off, and the plinths C (Figs. 1 to 4), which are 3½ in. deep by ¾ in. thick, put on flush with the top and bottom, and mitred together at the corners. To form the lid, gauge round from the top edge 2 in. down (see D, Figs. 1 to 3); saw round, keeping true to the line, and then plane off the edges true to a fit. The lid will now be just deep enough to carry a hand and tenon saw when the tools have to be packed for transit. The lid may be hung with 3½-in. wrought butts or cranked cross-garnet hinges, and should have a good double action spring lock. For lifting the box, two pieces of beech 3 in. wide, shaped as E (Figs. 1 and 3), are fixed on the ends by screws from the inside. Holes are made just above the centre (see Figs. 1 and 3); these carry rope handles. The interior of the chest is shown at Figs. 3 and 4, fillets being fixed on the ends to carry a light framing to form the tray F (Figs. 3 and 4) and recess for the drawers G. This framing is supported by a strut fixed inside the casing H, which is made to slide forward; the space beneath the drawers is for working drawings, sizes, etc. A small board J (Figs. 3 and 4) 3½ in. deep is fixed on the bottom and ends to carry compass, smooth, concave, and tee planes. Coat the inside of the chest with pale gold size, and the outside with good lead colour.

Polishing Goat's Horns.—In polishing a pair of goat's horns, remove any rough or uneven parts with a spoke-shave, then well scrape all over with a cabinet-maker's steel scraper or with the edges at the sides of a wood-worker's chisel. When the horn is fairly smooth, go over it with a rasp or file, followed by coarse sandpaper, then finer, then the finest. Now rub briskly with a piece of rag that has been dipped in oil and then into the dust, etc., which has come from the horns during the scraping, filing, etc. The horns should then be smartly rubbed with a rag dipped in whiting and sulphuric acid or vinegar, then with a rag dipped in oil and putty powder (oxide of tin). Now well rub the horns with a dry cloth, then with crumpled paper, and finally with the bare palm. The rubbing at each stage must be thorough; and between every two steps a good dusting of the horn should be given to prevent the larger particles of the one stage scratching the smoother surface gained in the succeeding stage.

Heat Insulating Composition.—The following recipe for a non-conducting composition has been given for use with steam pipes, etc. In water, mix fireclay with four times the quantity of small coal ashes to the consistency of thin mortar. Then mix equal quantities of dry calcined plaster and flour, each constituent equalling in quantity the amount of fireclay previously used. Add to the ash mixture. Two coats should be used, with a setting coat outside, as when plastering a wall.

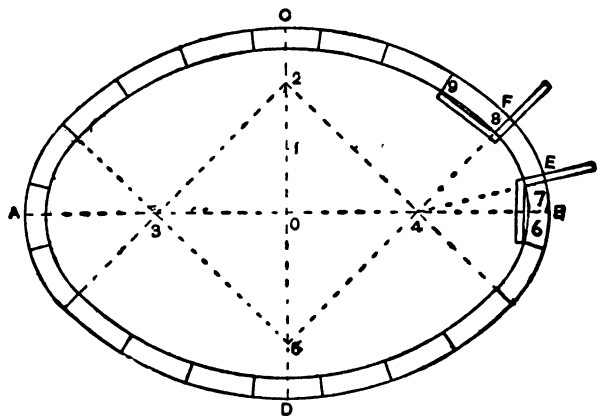
Modelling in Papier-mâché.—In making animal heads with papier-mâché, either a natural skull or one modelled in clay is obtained, and from this a plaster mould is taken. In this mould papier-mâché is forced, or sheet after sheet of pasted paper is pressed in every direction, and forced well into the hollows. When dry, the material easily comes away from the mould. To make papier-mâché, tear into small pieces a number of old newspapers, and boil until quite soft. The pulp should then be removed from the fire and squeezed. some thin glue and plaster-of-Paris added, and the whole beaten well together. If the material is too dry, add glue; if too sticky, add plaster. When rubbed on the hands it should leave a very thin coating.

Cleaning Aquarium Shells.—It is impossible to keep delicate shells fresh and clean at the bottom of an aquarium, for they quickly become covered with a green aquatic growth that defies all efforts to be scrubbed off The shells may be cleaned by plunging them in a boiling mixture of 1 part of hydrochloric acid to 10 parts of water Hold them with wooden tongs, and remove after one second to clean cold water. Repeat the operation if necessary, but if the shells remain in the acid beyond the prescribed time they will be eaten in holes, if not altogether dissolved. If the shells are to be replaced in the aquarium, it is not worth while to clean them repeatedly. Introduce a few fresh-water snails into the aquarium, and they will keep down the green growth.

Particulars of Oil of Turpentine.—Oil of turpentine, spirit of turpentine, and ordinary or common turpentine are all the same thing. Crude turpentine is turpentine as it is derived direct from the pine trees. Oil of turpentine really means the essential or volatile oil of turpentine after distillation. Oil of turpentine must not be classed with the ordinary kinds of oils, such as olive oil, etc., which are non-volatile, and have a different composition altogether. There is an oil of turpentine known as fat oil of turpentine, but this is simply ordinary turpentine that has been exposed to air for some time and has become thickened or partly resinified by oxidation.

Yellow Stain for Venetian Blinds.—A high-class satin stain for use on Venetian blind laths previous to varnishing can be obtained by dissolving 1 oz. of gamboge in 1 pt. of methylated spirit. A cheaper plan would be to mix dry yellow ochre, or 2 parts lemon and 1 part orange chrome, in weak glue size. This latter mixture should be brushed on, the surplus being wiped off with soft rag.

Determining Bevels for Joints of Oval Cask.—In finding the correct bevels for the joints of an oval cask first set out the oval or ellipse, and a good method of doing this is shown by the illustration. Let A B and C D be the given diameters. Divide O C into three equal parts. On line A B mark off A 3 and B 4, each equal to O 2. Make O 5 equal to O 2; then draw the radial lines from 2 and 5, passing through 3 and 4 as shown.



Determining Bevels for Joints of Oval Cask.

Then 2 and 5 will be the centres for the larger curves, and 3 and 4 for the smaller. Next set out the staves as shown. It will be seen that two bevels will be required. For the sharper-curved staves, as at B, join the points 6 and 7, then join the radial line 7 4, and draw E bevel as shown; the bevel at F can be obtained in a similar manner. The bevels here given are for application at the centre of the staves.

Forging Axles for Vehicles.—The iron for vehicle axles should be of the best quality. The method of working is as follows. A number of small bars are put up in a bundle sufficient to make an arm, and bound with iron rod to prevent falling about when working. The arm is then placed in the furnace, and thoroughly welded together. Whilst this is being done it is worked somewhat to the required shape. The collars are now made and welded on. For this purpose dies, or top and bottom tools, are used, the arm being worked at as great a heat as possible without burning, lighter heats being taken for finishing to the size required with light blows; afterwards turn and fit the axles. To case-harden, place the articles in an iron box or casing large enough to contain a packing of 2 in. or 3 in. of the hardening compound around each arm. The box should be sealed up air-tight at both ends. The compound generally used is leather shreds, ground raw bones, hydrocarbonated bone black, and sal soda, the whole being placed in a furnace and kept at a good heat for ten or twelve hours; then remove the articles from the box and cool out thoroughly. Where an extra hard casing is required the articles are re-heated, the box being filled with powdered potash and kept in the furnace until the potash is consumed. Where large quantities of axles have to be cooled out the cooling tub should be arranged to have an inlet of cold water at the bottom, so that the water made warm by the work would flow out over the top, thereby ensuring a continuous cool supply. The collar plates are stamped out of No. 6 fender plate, and when solid flaps are made in the axle, these plates have to be cut across one side to allow of bending back to get them on between the collar and the flap.

A Watch-case Galvanometer.—To make a simple galvanometer as in Fig. 1, get an old brass watch case with one of the brass plates removed. In the centre of this drill a very small hole to suit an endstone, such as jewellers use in watches. Then cut a piece of brass to fit across the diameter of the plate, $\frac{1}{4}$ in. wide and $\frac{1}{16}$ in. thick. Drill a hole at each end, and get two small brass pillars for the ends, about $\frac{1}{2}$ in. long by $\frac{1}{4}$ in. in diameter, to raise the cross-bar from the plate. Then drill a central hole in the bar, and put an endstone in this. Taper a piece of watch spring each end from the centre to form a pointer, drill a $\frac{1}{16}$-in. hole in the middle of it, fit a shaft in tight to the hand, and magnetise the pointer; pivot the shaft at the

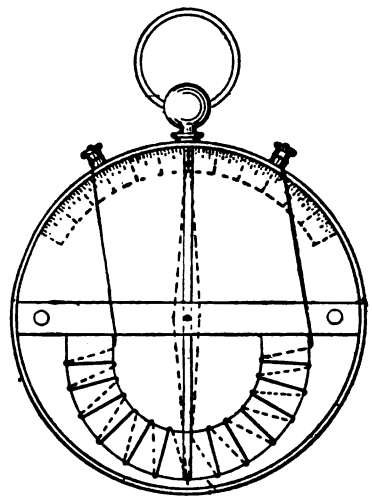
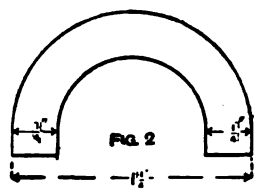


FIG. 1



Watch-case Galvanometer.

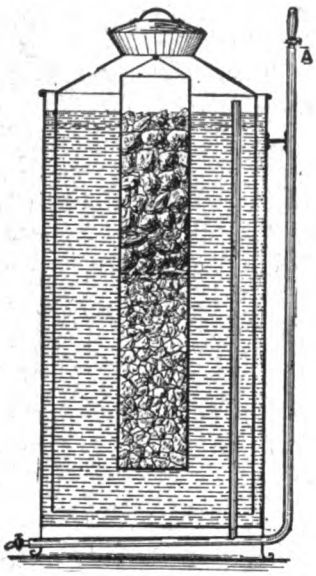
endstones. Next cut a piece of tin to the shape of Fig. 2, lap it with silk tape, varnish, and lap again with about 8 ft. or 9 ft. of No. 28 S.W.G. silk-covered wire. Next get a piece of spring steel, $\frac{1}{16}$ in. in diameter by $1\frac{1}{2}$ in. long, magnetise it, and fasten in cross section to the horseshoe magnet after taping and varnishing. Fasten these two magnets to the back of the brass plate by means of a short piece of ebonite and small screws at the ends. Drill two holes at each side of the case for the reception of two terminals, and connect as shown in Fig. 1. A scale, also, graduated as shown, should be affixed.

Soldering a Joint in a Watch Case.—To solder a joint in a watch case, the old joint must first be filed off clean. This should leave a semicircular groove in which the new joint can lie true. The joint is cut from drawn silver or gold tube. Place it in its groove, having first wetted it with borax paste and water. Along its side place a long thin strip of silver or gold solder, and apply a blowpipe flame to the case near the joint until it is well hot; then direct the flame on the joint until the solder runs. As soon as the solder sets, and while the case is hot, plunge it into a pickle made of sulphuric acid 1 part and water 9 parts, then wash in plenty of water, and clean up. Before soldering, unpin the back, bezel, and dome, and take out the bow, push piece, and any steel springs so that they may escape injury from the heat.

Making Black Crayons.—To make black crayons, mix 10 parts of pipeclay, 1 to 1½ parts of lampblack, and ¼ part of Prussian blue with water to a stiff paste. Well knead all the ingredients together. Allow the paste to remain for several days, then roll out on a board and cut into lengths. A better method, however, would be to press the crayons in a mould; they would be harder, more homogeneous, and less liable to break.

Green Stain for Oak Picture Mouldings.—To stain oak picture mouldings a bronze green, mix bronze green, procurable at paint stores, in hot vinegar or in dilute French polish. If the mouldings are to be polished, mixing in vinegar is advised. Some of the dry colour may then be mixed with the grain filler and also with the varnish, which will be required on oak in order to gain a solid body.

Acetylene Gas Generator for Magic Lantern.—Herewith is a sketch (one-eighth full size) of a portable and automatic acetylene gas generator for use with a magic lantern. The apparatus works well, and will



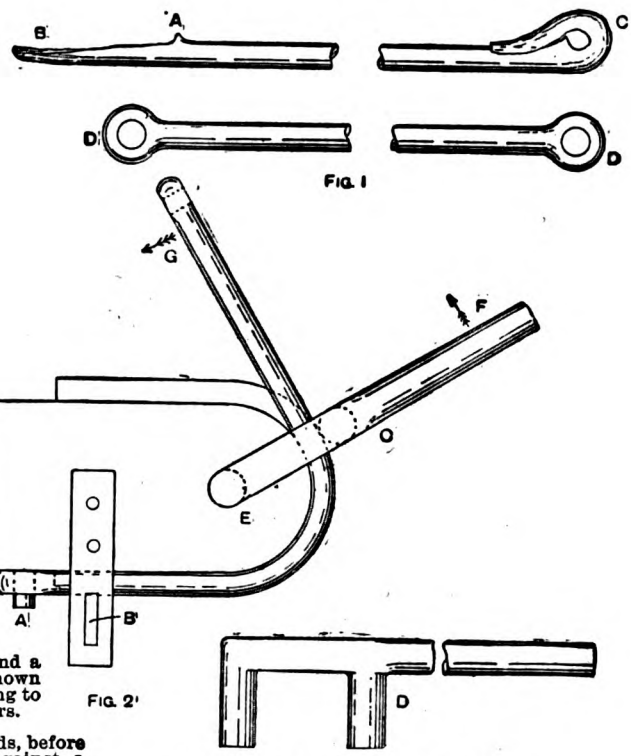
Acetylene Gas Generator for Magic Lantern.

give about 400 candle-power for about two and a half hours. In the illustration the carbide is shown on top of the lime residue. A is the pipe leading to the lantern, the lamp for which has four burners.

Polishing Tin-plate Goods.—Tin-plate goods, before being polished, are scoured by being held against a revolving mop greased sufficiently for the purpose by contact with a tallow candle. Finish by polishing with a dry mop on which some Sheffield lime is placed. When polishing tinware, the mop should be run at a speed just sufficient to cause it to stand out stiff; if the lathe is run at too high a speed, the mop will remove some of the soft surface tin.

Stains on Marble.—Marble erections against a backing of brickwork will in a year or so's time show a brownish stain, and probably this will gradually spread. The stains are caused by the close proximity of the marble to the brickwork. The marble, being of a crystalline and somewhat absorptive nature, has attracted the damp from the brickwork, and so become discoloured. In nearly all walls, especially those recently built, constant evaporation is taking place, and the effect of this evaporation is to draw the damp from the middle of the wall towards the surface. Marble work, therefore, should never be fixed solidly to a wall, but an air space should be left between it and the brickwork, with an open joint here and there to allow for the condensation that invariably takes place. It may be objected that, by allowing an air space, solid fixing could not be obtained, but this objection may be overcome by the judicious use of brass or copper cramps. There is no permanent remedy for the stains unless the marble-work is detached from the brickwork. The discoloured marble may, however, be bleached by treating it with a solution of soap lyes and whiting, but this bleaching will not be permanent. Mix the soap lyes and whiting to the consistency of a paste, and apply a good coating with an old brush. Let this paste remain on the marble for a couple of days, then wash off with clean water—rainwater for preference—repeating the process two or three times until the stains have been removed. To make the lyes, obtain, say, 7 lb. of American potash from the drysalters, and dissolve in a pailful of rainwater. The lye is of such a caustic nature that it is dangerous to fingers and nails. If, therefore, any of the liquid gets on the hands, they should be at once well washed in water containing a few drops of vinegar or acid to neutralise the alkali.

Making Railway Coupling Shackles.—To get railway couplings to stand, the grain of the iron in the shackles must follow round the eyes. To accomplish this, the bar is first nicked with the fuller as shown at A (Fig. 1), and the end drawn out to form a scarf as at B, which is bent



Making Railway Coupling Shackles.

over as at C and welded, the eyes D being finished on the anvil with a pair of tools and a punch. The part between the two eyes is then heated and the bar placed with one of the eyes on the stud of a bending block A (Fig. 2), and fixed by means of a cotter at B. One of the horns of a bending tool C and D (Fig. 2) is placed in a hole E in the block, and the handle pulled round towards the arrow F, the bar following in the direction shown by the arrow G until the shackle is bent to the required shape. Fig. 2 shows the bending block in plan, and C and D are two views of the bending tool. The shackles are made of 1-in. to 1½-in. Lowmoor or Yorkshire iron, according to the class of vehicles on which they are used.

Cleaning Leather-work Brackets.—To clean a pair of leather-work brackets mix a little carbonate of magnesia with benzoline to form a thin fluid, and apply it, in large quantity, quickly to the leather. Place the brackets in the open air to dry, then with a light feather brush dust out all the dry magnesia. If this does not serve the purpose, the only way of giving the bracket a good appearance will be to cover the leather with a buff flatting paint of a suitable colour.

How to use a Twaddel's Hydrometer.—Twaddel's hydrometers are sold in sets of six or separately; they read as follows:—

No. 1.	0°	to	24°	= sp. gr. of	1·00 to 1·12.
,, 2.	24°	,,	48°	= ,,	1·12 ,, 1·24.
,, 3.	48°	,,	74°	= ,,	1·24 ,, 1·37.
,, 4.	74°	,,	102°	= ,,	1·37 ,, 1·51.
,, 5.	102°	,,	138°	= ,,	1·51 ,, 1·69.
,, 6.	138°	,,	170°	= ,,	1·69 ,, 51·8.

The specific gravity of a liquid is determined by floating one of the hydrometers in some of the liquid, contained in a tall glass cylinder; if the hydrometer is suitable for this particular liquid, the instrument will sink until the surface of the liquid coincides with some mark on the stem of the hydrometer. Suppose the strength of a caustic soda solution is to be determined, and a No. 2 hydrometer is to be used, the level of the liquid reaching 30°, the gravity of the liquid is 30° Tw.; or, if multiplied by 5 and 1·000 be added, its true specific gravity, *i.e.* 1·15, will be obtained; then the solution will be found to contain about 13 per cent. of caustic soda.

Hydraulic Mean Depth.—The hydraulic mean depth of a liquid flowing through a pipe is equal to the sectional area of liquid divided by the wetted perimeter. The

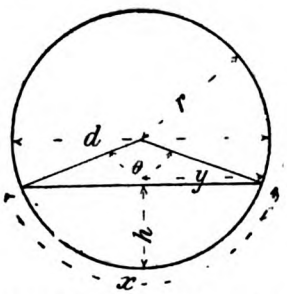


Diagram of Hydraulic Mean Depth.

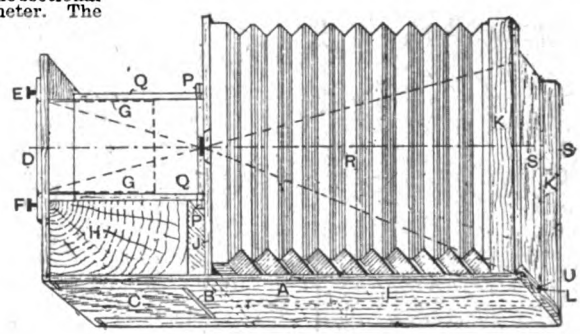
sectional area of liquid is equal to $\frac{1}{2}r^2(\theta - \sin.\theta)$. The wetted perimeter equals $\frac{\pi d \theta}{360}$; ∴ hydraulic mean depth = $\frac{\text{sectional area}}{\text{wetted perimeter}} = \frac{\frac{1}{2}r^2(\theta - \sin.\theta)}{\frac{\pi d \theta}{360}} = \frac{90r(\theta - \sin.\theta)}{\pi\theta}$.

Knowing the diameter of the pipe and the depth of the liquid, the angle θ may be found from the equation $\tan\frac{\theta}{2} = \frac{y}{r-h}$, where y equals $\sqrt{(d-h)h}$. The hydraulic mean depth for pipes running full or half full is $\frac{d}{4}$.

Power Saw for Soft Stone.—The ordinary frame saw originally intended for sawing hard stone, and driven by power, is now used successfully for sawing Bath and other soft stones, including Beer stone and alabaster. The saw is a long steel blade parallel in width and thickness, from 10 ft. to 12 ft. long, 9 in. wide, and nearly ¼ in. thick; it has coarse teeth, with a wide set for clearance; it is easily fixed in the frame by tightening or keying up with a kind of wedge like that used for the hard-stone saw. When in motion the saw is fed with water, sufficient only being used to keep the cut from clogging. The rate of speed (steam power) is from twenty-five to thirty strokes per minute, and a block of Bath stone 8 ft. long by 3 ft. deep can be cut through in from half an hour to three-quarters of an hour, according to the hardness of the stone.

Staining Plaster Panels to Imitate Mahogany.—Cast plaster panels are made to match mahogany in the following manner. Procure three bottles, and place ¼ pt. of methylated spirit in each. In No. 1 steep ¼ oz. of gamboge; in No. 2 1 oz. of dragon's blood; and in No. 3 1 oz. of red sanders; this will give one shade of yellow and two shades of red. Mix the various shades with an equal bulk of polish; apply with a camel-hair brush. Blend carefully together, building up the desired tones gradually by using the colours weak rather than by trying to get the exact tone by one application. Give the stains a thin coat of spirit varnish, then finish bright or dull as desired.

Enlarging with Pocket Kodak.—A pocket kodak camera may be used for enlarging, as shown in the sketch. A is a baseboard about 15 in. long by 6½ in. wide. The exact dimensions will depend upon the size of the camera and the focus of the lens. A slot is cut at B to take a tongue C about 2 in. long. To this is fitted the adjustable negative (or film-holder) frame D. This runs in rails like a rising and cross front, and is clamped when in proper position by the thumbscrews E and F. On the inner side of this is a box G fitting closely inside the camera (film end). D is attached to C by the block H, which, resting upon the sides of A, holds everything firm and steady. At J is fitted the front of the enlarging camera, with the opening before the lens and a shallow frame P fitting closely around the kodak. (The kodak Q is, of course, supposed to be removed from its outer box.) Attached to the front by bellows R is a grooved frame K large enough to take a half-plate printing frame—that is, about 8 in. by 6½ in. Through this from the frame runs an iron or brass rod L, over which a staple U may be turned to clamp it and thus hold the frame K tightly in position. When a film is used it is fixed, to keep it flat, between two pieces of glass and inserted in frame D, the film towards K. A sheet of ground glass is then placed in the printing frame, the rough side of the glass towards the operator, and the frame is placed in the grooves S of K, which is then extended almost to the full. D is next extended until the image thrown on the ground glass is nearly sharp. The fine focussing is done by



Enlarging with Pocket Kodak.

manipulating K. It is then clamped by U over L. Adjust finally in position by screws E and F. Now replace the ground glass with plain glass and place against it the film side of the bromide paper or plate, and fill in the frame back. Cover the enlarging camera with a thick dark cloth and burn some magnesium ribbon before D. The bromide paper is then developed like a contact print. If only one degree of enlargement is required, the bellows may be replaced by a rigid box.

Extracting Salt from Sheepskin Rug.—Suppose it is required to treat a white sheepskin rug which, during damp weather, becomes covered with moisture. First remove any lining or edging that is on the skin, mix together bran and hot water, and with this mixture immediately cover the bottom of a wooden trough to a good thickness. Upon this place the skin with the wool folded inside. Then place on more bran, fold over again, more bran, and so on until the skin has been completely covered. Then pour on hot water until the whole has been covered. Leave in this state for a day, when the salt will disappear. Wash in clean warm water, and dry in the shade, constantly beating or shaking it. When nearly dry, well rub it.

Watches Stopping in One Position only.—When a watch will go in one position and stop in another, the fault can generally be traced to a defective pivot or pivot-hole; thus, if the watch be held so that the balance works on one pivot or in one pivot-hole, and the watch stops, that pivot or hole is probably damaged. The pivot may be bent, its end may be bruised and resemble a "mushroom," or it may be too short to come through the jewel-hole and touch the endstone. The jewel-hole or endstone may be cracked. Other causes may be too much endshake to the balance; the balance arms may touch the index curb pins or the hairspring stud; the balance rim may touch the balance cock or the watch-plate, or (in a Geneva) the centre wheel; the hairspring may not be flat, and may touch the balance arms or the balance cock; the lever may touch the roller, or the 'scape wheel may touch the top or bottom of the slot in the cylinder.

Preserving Berries.—In preserving winter berries, immerse them in a fairly strong cold brine prepared with ordinary table salt and water. The berries will keep in this way for a long time. Artificial berries are nearly always used for decorative purposes, because of the great difficulty in keeping the natural berries in an unshrivelled state.

Making Waterproof Overalls or Oilskins.—Unbleached calico is generally used for cheap oilskins, fine drill for better-class goods, and sometimes, but rarely, silk. Best linseed oil, with very little driers, is the most suitable dressing, and should take about two months to dry in a cool, airy place. Lampblack is the cheapest suitable black; ivory black is better, but dearer. One pound to 2 lb. of lampblack may be used for 1 gal. of oil. If oil alone is used, 1 lb. to 1½ lb. of driers for 1 gal. of oil may be added; with lampblack, 2 lb. to 3 lb. of driers. Ochre is the only yellow pigment cheap enough to use. If the solution has to be made quickly, use plenty of driers, and hang the articles up to dry in a room artificially heated. The solution should be laid on with a stiff brush or scraper in a thin layer, and the first coat must be allowed to become thoroughly dry before putting on a second; two or three coats will be required. The articles should be hung on sticks so that no two portions of the cloth touch. Boiled oil, coloured with ochre or lampblack, and a dash of driers is also used. It is recommended, in order to keep the oilskins from becoming stiff, that yellow soap cut into shreds should be dissolved in the waterproofing paint, the proportions being 1 oz. of soap to 3 pt. of paint. A little beeswax dissolved in the paint is also used for the same purpose. A good black dressing is boiled oil and lampblack 1 qt., to which the white of five eggs and 1 oz. of melted beeswax are added; give two coats, and allow each coat to dry thoroughly before the next is applied. The drying will occupy quite two weeks. If the drying is not thorough the dressing will become sticky. If driers is used the oilskins are apt to crack. If the dressing is too thickly applied it will peel off where exposed to friction.

Cross in Telescope of a Level.—The cross used in the telescope of a level is fixed in the eye end of the instrument, and just within the focus of the eyepiece, generally 1 in. from the eye end. But this varies according to the focal length of each eyepiece. The wires are taken from the spider, and directly laid over the diaphragm, to which they are attached. Experiments have been made with other material, but the spider's web has proved the best for the purpose. The diaphragm is a ring of metal about ½ in. less in diameter than that of the tube into which it is inserted. Four screws which pierce through the tube hold it in position and serve for adjustment. The ring is bevelled in its inner circumference in order to provide a clear edge. The face to which the wires are fixed is marked off for the number and position of lines wanted; then the web is stretched across in the marks made, and secured at each end by a drop of varnish.

Comparison of Formulæ for the Discharge of Water in Pipes.—The fundamental formula for calculating the velocity of water flowing through a pipe or channel, and for calculating the rate of discharge, is based on that of Chezy, a French engineer, who proposed in 1775 the formula

$$V = c\sqrt{RS}$$

Where

V = mean velocity of water in feet per second.

R = hydraulic mean depth = $\frac{\text{area in sq. ft. of cross-section}}{\text{wetted perimeter in feet}}$

S = slope = $\frac{\text{inclination of water surface}}{\text{length of pipe or channel}}$

c = a coefficient determined by experiment and fixed by Chezy at 93·4. This formula was further investigated by Eytelwein, a German experimenter, between 1814-15, and slightly modified, but his form gives practically the same result. The next important formula proposed was that by Neville in the middle of the century, giving a different value for the coefficient c from that of the earlier experimenters. About this time Weisbach introduced his well-known formula, which has been for the last thirty years so much used by hydraulic engineers in this country; it is more complicated than any previous one, a varying coefficient c being given, depending on the rate of the velocity. From 1850 to 1853 M. H. Darcy began in France a remarkable series of experiments on open channels and pipes, on a much larger scale than had previously been attempted. Darcy died in 1858, and his work was continued by his assistant, M. H. Bazin. The latest, and by far the most important, researches on the flow of water are due to Gangullet and Kutter, of Berne, who published their researches in 1869 and 1870. These experimenters continued on the lines of Darcy and Bazin, and found that the Chezy formula could be adapted to all cases, but that the value of the coefficient c varies under very many conditions instead of remaining constant, as in the early form. Kutter established a series of "coefficients of roughness" which have been largely experimented upon in America, Germany, and England, and have been proved to be substantially accurate. The following table shows more clearly the great difference between different formulæ. Comparison of formulæ:—

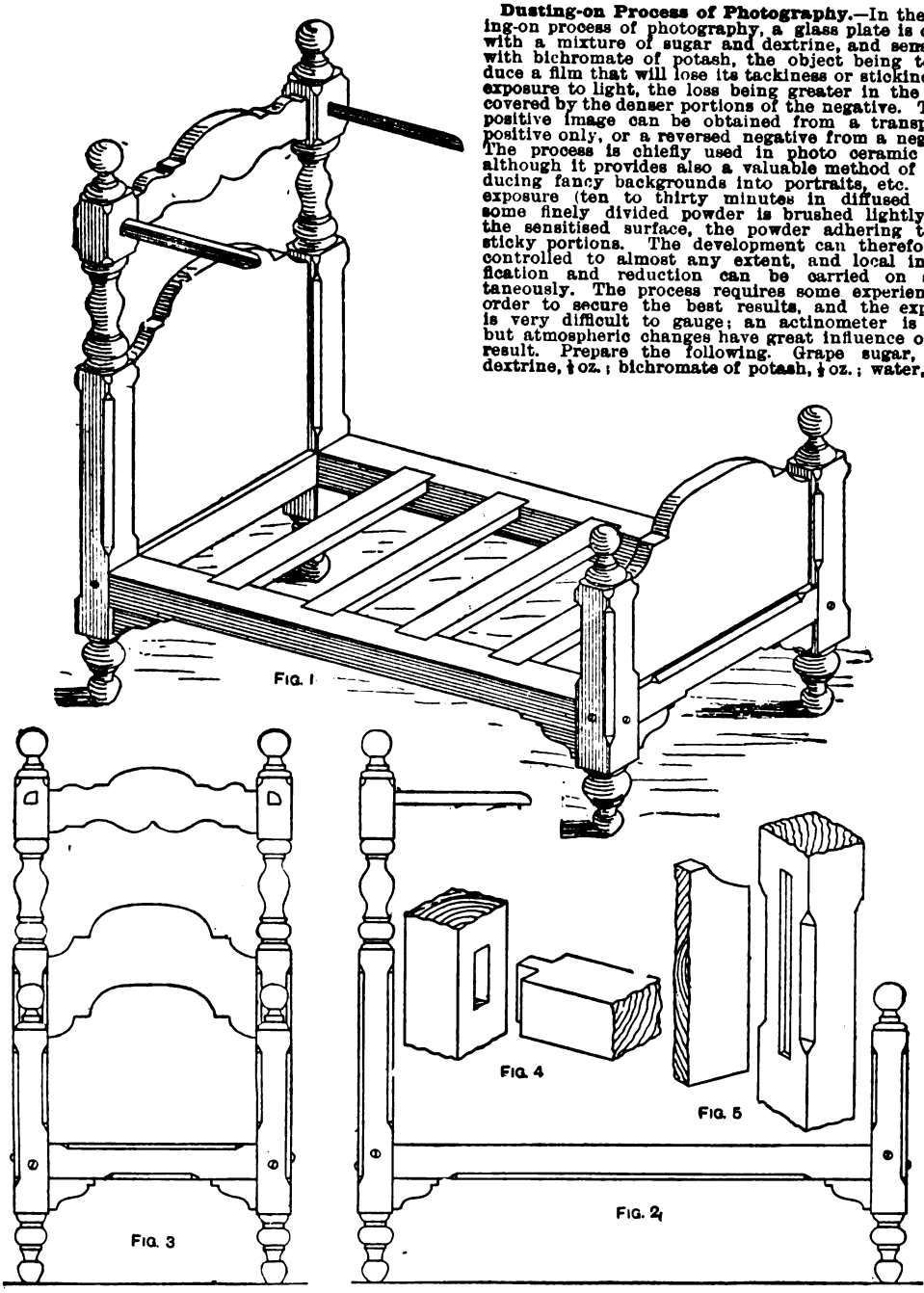
PIPES RUNNING FULL-DISCHARGE IN CUBIC FEET PER MINUTE.

Authority for Formula.	INCLINATION.											
	1 in 50	1 in 150	1 in 80	1 in 250	1 in 500	1 in 100	1 in 300	1 in 750	1 in 500	1 in 1500	1 in 1500	1 in 3000
Chezy	55	32	248	140	99	1253	723	457	3170	1830	5043	3563
Eytelwein	55	32	248	140	99	1256	725	458	3180	1833	5054	3577
Neville	65	35	290	157	106	1549	826	490	—	—	—	—
Weisbach	60	34	238	148	102	1357	779	478	3431	1910	5344	3676
Box (hydraulics) ...	54	31	240	137	97	1230	705	443	—	—	—	—
Darcy	61	35	286	162	113	1485	860	533	3816	2202	6072	4274
Kutter	41	24	225	127	90	1133	654	414	3340	1925	5750	4020
Santo Crimp	51	29	259	147	103	1472	850	533	4181	2375	6891	5033
	6-in. stoneware.		12-in. stoneware.			24-in. brick.			48-in. brick.		72-in. brick.	

New formulæ proposed are either modifications of the Darcy and Bazin or Kutter forms, or, being dependent upon a single isolated experiment, are not entitled to any authority.

Making Gold Wire Name Brooches.—The wire employed for making American name brooches is a hard, tough brass of a gold colour, coated with gold. Various qualities are used, from a lightly gilded wire costing 5s. per pound to a heavily gold-cased wire costing 5s. per ounce. The higher priced wires were first imported under the name of "American rolled gold" wire, but wire of an equal quality is now sold as "seamless gold plating wire." The gauges in general use for this purpose are Nos. 20, 21, and 22, round, and half-round for rings; also square and other shapes for bracelets, scarf pins, and ornamental articles. For name brooches, No. 20 is best suited to bold designs with flowing curves, and No. 21 for more compact forms, whilst No. 22 is only used in making names with small letters. But the condition of the wire also assists or retards the workman in working out his design. A hard wire is liable to break if bent sharply, and is also too springy to retain its shape after being bent; whilst a wire that is too soft, although easily bent whilst making a brooch, will as easily bend and crush out the design after being worn a few times. The tools for this class of work consist only of a pair of small round-nosed pliers, a pair of cutting pliers, and a small fine-cut file; these can be bought at any toolshop. The best designs and patterns for a novice are a few of the lower priced brooches, pins, rings, and bracelets. It is advisable for the beginner to imitate first the simpler designs, such as for an initial scarf pin, in some cheap wire, until a certain proficiency has been attained. Hard-drawn copper wire of No. 20 gauge will be found suitable for this purpose. The stem of the pin may be grooved spirally with one edge of the file, and pointed with the same tool. Twisted pins are made with square wire, held in one pair of pliers and twisted with another pair. When proficiency has been attained in making scarf pins, a safety pin, or a brooch with a simple, short name, may be attempted. Skill in working the wire can be attained only by first practising on copper or some other cheap material.

Design for a Doll's Wooden Bedstead.—Figs. 1 to 5 show the construction of a doll's bedstead. The size will vary according to requirements; any kind of wood may be used. The posts and rails can be jointed by stub tenons and mortises as shown at Fig. 4, then glued together; they may also be further secured by round-headed screws. The head- and foot-boards may be housed into the posts a little distance as shown at Fig. 5. This design, carried out on a larger scale, would make a neat little bedstead for a child. Fig. 1 is a general view, Fig. 2 a side elevation, and Fig. 3 is an end elevation showing the head. Figs. 4 and 5 show joints, as has been said.



Design for a Doll's Wooden Bedstead.

Dusting-on Process of Photography.—In the dusting-on process of photography, a glass plate is coated with a mixture of sugar and dextrine, and sensitised with bichromate of potash, the object being to produce a film that will lose its tackiness or stickiness on exposure to light, the loss being greater in the parts covered by the denser portions of the negative. Thus a positive image can be obtained from a transparent positive only, or a reversed negative from a negative. The process is chiefly used in photo ceramic work, although it provides also a valuable method of introducing fancy backgrounds into portraits, etc. After exposure (ten to thirty minutes in diffused light) some finely divided powder is brushed lightly over the sensitised surface, the powder adhering to the sticky portions. The development can therefore be controlled to almost any extent, and local intensification and reduction can be carried on simultaneously. The process requires some experience in order to secure the best results, and the exposure is very difficult to gauge; an actinometer is used, but atmospheric changes have great influence on the result. Prepare the following. Grape sugar, ½ oz.; dextrine, ½ oz.; bichromate of potash, ½ oz.; water, 10 oz. Whilst this solution is filtering, clean some glass plates, coat them, and dry them slowly over a spirit lamp. Expose as above directed, and allow the plate to stand aside and absorb some moisture from the air. Dust over the powder, and coat with collodion as a protective varnish. A good washing in water serves to remove the bichromate salt.

Hollowing Tinplate.—A hollowing block cut preferably from the trunk of an oak or beech tree will be required for hollowing tinplate; a convenient size will be about 3ft. high and 2ft. 6in. in diameter. The holes on the top end are cut in varying depths and diameters with a small adze. If a variety of hollowed articles is to be worked, a set of block hammers will be required. These comprise a bullet-faced hammer for covers; a hammer with the faces curved to a greater radius than the first named for kettle bodies and similar work; and one with the faces flatter than either of the two former ones for canister bodies, etc. When working the metal, if a circle is to be hollowed, place the metal so that the edge of the circle is over a hole in the block of suitable depth, and then hollow it by delivering regularly with the hammer a series of blows first round the edge, and then in a series of concentric circles as far in towards the centre as may be desired. The work is then smoothed by again going over the hollowed part with light regular blows, or giving a series of radial strokes upon a planishing wheel. When hollowing ovals, such as a kettle top, the sides of the oval do not require so much hammering as the ends. If the shape is a rectangle, or an oblong with round corners, the corners are the parts that require most working. Hollowed work in tinplate is usually executed in "tacks" of four or six discs or ovals, according to the thickness of metal used.

Stephenson's Thermometer Screen.—The sketch shows a Stephenson's thermometer screen, which consists of a box, either square or oblong, raised 4ft.

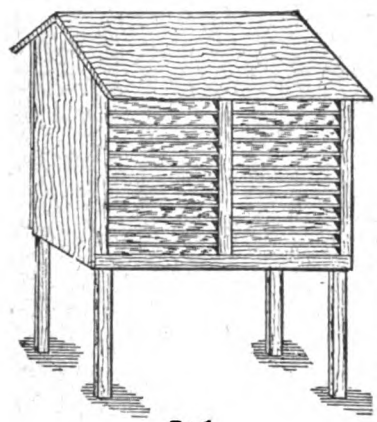


FIG 1

FIG 2

Stephenson's Thermometer Screen.

from the ground. The box may have louvred sides, that is, the sides may be made in a similar way to wooden shutters for windows, thus allowing air to penetrate, but keeping out the direct rays of the sun. But it is preferable to have the louvred sides double, as illustrated in section by Fig. 2, and not single louvred. In strong winds, direct draught on the damp cotton surrounding the hygrometer wet bulb would produce undue evaporation, and give a lower temperature than would be given by the same thermometer when standing in still air of the same temperature. The double louvre minimises the risk of direct draught, and keeps the enclosed air as still as possible. The box is open below and has a wood partition through the middle upon which the thermometers may be fixed. The roof is sloped, and may be painted or covered with tarred felt. The size of the box is not important; but if it is made smaller than 3ft. by 2½ft. by 2ft., it will be necessary to have a hinged door at each end through which to take the readings of the thermometers.

Principles of Hydraulic Lifts.—Hydraulic lifts are of many forms and sizes, from the small dinner lift to the passenger or luggage elevator. The principles on which they work are very simple, and can be illustrated by a common syringe or squirt. If the nozzle of such an appliance is attached to a cock on a water pipe, a piece of indiarubber tubing will do for making the connection, and the piston or plunger is pushed in as far as it will go before starting. On turning on the water, the piston will be forced outwards, and if stood or held upright a load or weight placed on the top would be raised. The weight of the load it would lift would be in proportion to the pressure of the water in the main and the area of the end of the piston or plunger. If the pressure in the main is say 50lb. per square inch, and the end of the piston an area of 1sq. in., then 50lb. of weight could be balanced. If one-third of the power is absorbed by the friction between the cylinder and the packing or gland, then $\frac{50 \times 2}{3} = 33{\cdot}3$lb. equals the load that would be raised, the load including the weight of the piston and carriage, car, or platform upon which the load to be lifted rests. If the area of the above piston end was equal to 100sq. in., then $\frac{100 \times 50 \times 2}{3} = 3{,}333{\cdot}3$lb. (which is the load piston, cage, etc.) that would be raised.

Construction of Fireguard.—Fig. 1 shows the fireguard complete as it would stand round the fireplace. It should be of a size to fit against the centre of the mantelpiece jambs, and should stand about 30in. high, though the height may be varied according to the position. The top rail should be of flat iron ¾in. wide by ¼in. thick, and the bottom bar 1in. by ¼in. These are bent as shown in Fig. 1, leaving the ends 12in. long. This size may be either less or more according to the size of the room. The rails are drilled to receive the standard bars at intervals, leaving 3in. space between the bars. The bars of round iron ¾in.

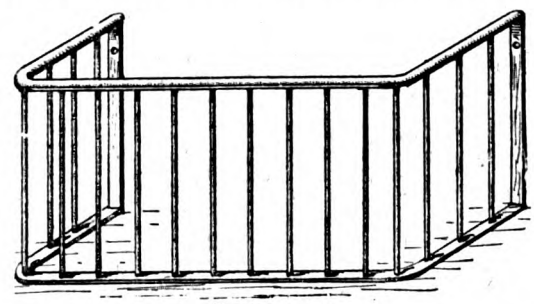


FIG. 1

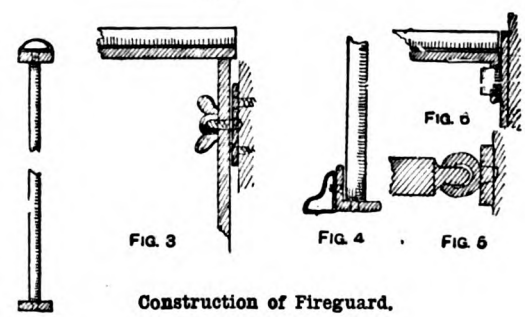


FIG. 2

FIG. 3

FIG. 4

FIG. 5

FIG. 6

Construction of Fireguard.

in diameter must be reduced at each end and then riveted into the rails (see section, Fig. 2). The back standard bar should be of flat iron 1in. by ¼in., with a round hole drilled through at 6in. from the top to receive the screw on the plate, which is fixed to the mantelpiece, and to which the fireguard is secured by a thumb-nut (see Fig. 3). Another method of securing the guard to the mantelpiece is shown at Figs. 5 and 6. The top rail is turned down to form a hook, which falls into an iron eye on a plate fastened to the mantelpiece. The guard may be made more ornamental by using an angle-iron rail instead of flat iron for the bottom, and fixing on the front a brass ogee moulding (see Fig. 4) and on the top rail a half-round brass moulding (see Figs. 2 and 3). The guard may be painted dead black or any tint of enamel as individual taste may direct.

Repairing Broken Cornice of Ceiling.—If the broken cornice is a fluted one, make a zinc mould of it, using the good part of the cornice as a pattern. Remove all loose plaster, dust with a stiff brush, and well wet the cavity with water. Mix to a proper consistency a sufficient quantity of Keene's plaster, beat it up to a thick paste, and apply with a trowel and sash tool; gradually fashion the cornice by drawing the zinc mould backwards and forwards until the new portion of the cornice lines with the old. If the cornice is an ornamental one, the broken part must be made good by a casting from a mould taken from the unbroken part of the cornice

Whitening a Discoloured Ceiling.—In whitening an old paper-lined ceiling that has gone a bad colour, clean off the ceiling and remove all loose paper; then apply a coat of size, which may be made by dissolving 6 oz. of glue in 6 pt. of water, and stirring in a handful of plaster-of-Paris. To make a good job, line the ceiling with lining paper and butt the joints: for a strong job, catch-lap the joints. The ceiling may then be whitened in the ordinary way. If the ceiling is a very large one, use Irish moss instead of size with the whiting, as the moss will keep the joints from setting.

An Easily-made Snow Plough.—For the construction of the snow plough here illustrated, two elm slabs about 5 ft. by 10 in. by 1½ in. are required; the planks might be longer and wider with advantage. Cut one end of each plank as at A B (Fig. 1); then place it on the second, and draw a line along A B as a guide by which to cut the second. Place the planks edgeways, as in Fig. 2, and decide the angle at which to fix them. A suitable angle will make the ends C and E 2 ft. 6 in. or 3 ft. apart. Lay E F edgeways on the edge of C D at D at the proper angle, and mark the bevel at D. Then, having fixed C D edgeways, cut down this bevel line with a saw. E F, when placed against this bevel, will now form the angle required, the outer edge being bevelled to a sharp edge. Two strong pieces of wood should then be cut to the length of the cross rails. Place all in position before nailing together, and mark with a pencil the ends of the rails on both planks. Then bore holes from the inside to the marks, and, when all is ready, nail the side pieces together with 3-in. or 4-in.

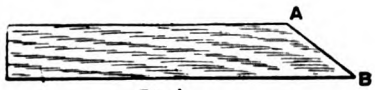


FIG. 1

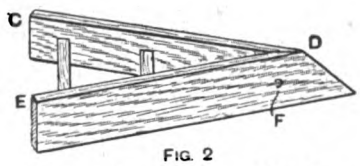


FIG. 2

An Easily-made Snow Plough.

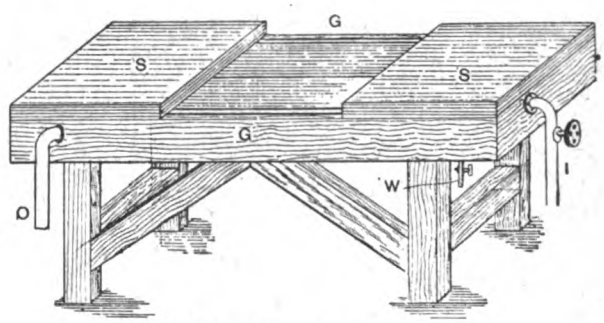


Table for Silvering Plate Glass.

wire nails. Place the rails in position, and nail from the outside through the holes already made. A piece of tin, such as a tin canister flattened out, will, if nailed on the front edge at D, ease the passage through the snow. A strong staple should be placed at each side, as at F, for harnessing a pony or horse to draw the plough. When in use, some heavy logs or a box of stones should be tied on the plough to prevent it rising over the snow.

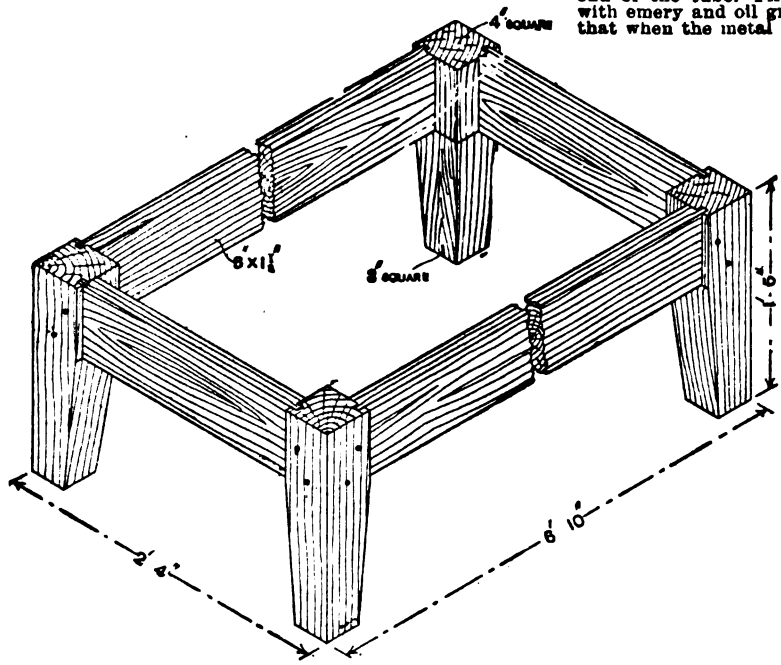
Setting and Preserving Butterflies, etc.—Insects to be preserved in a collection should be killed separately in a wide-mouthed stoppered jar, at the bottom of which is cyanide of potassium covered with plaster-of-Paris. As soon as it is quite dead, remove the insect from the bottle, catching hold of it by the middle—that is, where the legs join the body—and use a pair of tweezers, not fingers or anything as clumsy. Suitable tweezers can be bought at many shops, and can be made by bending double a strip of thin sheet steel or brass ⅛ in. or ¼ in. wide and 6 in. or 8 in. long till the two ends meet and form a delicate substitute for forefinger and thumb. The spring of the metal at the bend should keep the ends about ½ in. or 1 in. apart. The ends can be filed to a blunt point. Touch the insect as little as possible, and always catch hold of it by the thorax. The wings and other parts of butterflies and moths are covered with minute feathers, which are rubbed off and defaced at the slightest touch. The dead insect stiffens and dries up rapidly; therefore, have ready a setting board, on which to hold it in position whilst drying. The setting board is made by gluing two strips of soft, smooth cork, each 9 in. by 1 in. by ½ in., to an under-piece of wood 9 in. by 2¼ in. by ½ in. The two cork strips are glued to the wood with a ½-in. groove between their longest edges, and the cork is slightly bevelled off on the outer edge. Insect setting boards used by Continental naturalists are, however, quite flat; but English naturalists consider insects to be spoilt if set flat. Of course, the larger the insect the wider will the board require to be. In the ½-in. groove the body of the insect lies whilst its wings are extended over the cork on each side. Along the bottom of the central groove glue a strip of cork. Having laid the dead insect in the groove, a pin is pushed vertically through the centre of its thorax down into the cork; the height of the latter should be just sufficient to bring the wing above the edge of the side cork, and packing must be inserted where necessary to ensure this. An entomological pin, long and thin with a small head, is used. If the wings can be spread with a couple of sparrows'-tail or flight feathers fixed in a handle, all the better. Contact with fingers or tweezers or such like spoils the wings. Small slips of letter-writing paper are used as straps to hold the wings in their extended position, a couple or more of ordinary pins being stuck through each strap, but not through the wings. Use plenty of straps to keep the wings extended; put the set insect aside for a week or so, remove the straps, and stick the sample inside a store box or case. Camphor enclosed with the specimens will preserve them from mites, which otherwise might spoil a valuable collection. In the busy insect season many adopt the system of leaving the killed insects to dry unset, so that they may be relaxed and set properly at leisure. Dry insects are easily relaxed by keeping them on damp sand for a few days, when they may be treated on the setting board precisely as if they had but just been killed.

Table for Silvering Plate Glass.—The illustration shows a hot table suitable for use in silvering glass; it has the middle slate removed. One-inch board should be used for the top of the table, the slate top S being 1½ in. thick. The inside should be lined with zinc to make it airtight, the zinc being brought over the side. The slate slab should be bedded in red-lead, all joints being filled with red-lead mixed with varnish. The table must be quite level. A blanket or piece of felt should be placed over the slate when in use, and made wet with water before the steam is used. Steam should be turned on gradually by a valve at I; the hotter the table the quicker the silver will deposit. The outlet pipe O for steam is absolutely necessary, and could be regulated by a valve, as the confined steam would lift off the slate. The outlet pipe should be led to a convenient place so as not to interrupt a clear passage round the table. The pipe W in the bottom of the table is to let out the water formed by the condensing of the steam. The zinc is turned into the groove G, which is also for the bed of red lead. The glass to be silvered must be chemically clean, and whilst still wet from the washing it should be placed on the hot table and have a solution of gelatine or other mordant poured over it. Before this hardens, cover the glass with a saturated solution of nitrate of silver, and allow to remain untouched for about ten minutes. After wiping with a leather squeegee, again apply the silver nitrate solution, and complete the process by a final wiping with the squeegee.

Polishing Cornelian Stones.—Perhaps the best way of polishing cornelian stones in the rough is first to grind them level on a suitable stone, or on a piece of Yorkshire grit obtained from a tombstone cutter. The stone must be kept wet. When a level face is procured, grind out all the markings with emery powder, not too fine; use this on a thick sheet of lead with water. On another sheet of lead grind with a finer emery all marks left by the first emery. Then grind with finest emery on another sheet of lead; by this time there will be a dull polish. When no scratches are visible, polish with putty powder on a piece of felt or leather. Two things must be remembered: Do not stop grinding with one powder until all markings of a previous grinding are removed; and secondly, all the grindings must be wet.

Spinning Copper.—Copper is one of the easiest metals to spin in the lathe, because it is pliable and can be annealed straight off when it becomes hard. The tool must bear on the metal with firmness, but it is best not to take too large feeds, but to mould the metal gradually. It is of great advantage to hold a piece of hardwood against the back of the blank, particularly in the earlier stages. When the blank is first put on the chuck, or after it has been annealed, it feels very soft and yielding, but after a short time it gets harder, and it is not wise to work it too hard. The tool should not be moved from centre to circumference only; that would tend to draw the metal away from the centre and make it thinner there and more liable to break. When the tool has travelled from the centre outwards, let it travel back again to the centre; in this way the metal can be kept of the same thickness throughout. If the blank is fixed to the chuck by a screw through the centre, turn the chuck gradually during the spinning and anneal rather often.

Bier Stand for a Mortuary.—The accompanying sketch shows the construction of the frame of a mortuary bier stand. All the dimensions are clearly marked on the sketch, and when the top is boarded over with 1-in. boards (which should run across the frame),



Bier Stand for a Mortuary.

overhanging at the sides and end about an inch, the stand will be complete. The stands may be made of deal, but oak is preferable, though of course more expensive.

Particulars of Microscope Slides.—Some microscope cells are made by painting rings of marine glue upon a slide, and repeating this until the cell is deep enough Other cells are formed by cementing pieces of plate glass (with the interior removed) to the slides; whilst others, known as "sunk cells," are formed by grinding out a hollow in the slide. Others, again, are known as "tube cells," being formed by cementing a section of round or rectangular glass tube to the slide glass. These may be of any size. There are also "built-up cells," made by cementing separate pieces of glass together.

Making Carbon Paper.—In preparing black carbon paper either of the two following compositions may be used. (*a*) Finest lampblack 5 parts, olive oil 5 parts, cerasin wax 1 part, and petroleum ether 10 parts. (*b*) Lampblack 5 parts, cerasin wax 6 parts, olive oil 5 parts, and petroleum ether 15 parts. The lampblack and oil are ground together in a mortar, transferred to a small dish or pan and slightly heated, and the cerasin wax added; when the latter has thoroughly melted, well stir the mixture, remove it to a safe place, and while still warm add the petroleum ether. For a bluish-black shade, add a little Prussian blue. The mixture, while warm, should be applied with a brush to paper that has been heated in an oven. After the application, lay the carbon paper on an old newspaper and return to the oven to allow the mixture to soak in. After about half an hour's heating any excess of fluid may be removed with a cotton rag; the paper will be fit for use on cooling.

Making Opalines.—In preparing opalines, immerse a photographic print in a 5-per-cent. solution of gelatine. Warm the glass, and pour on it in a pool a portion of the gelatine solution; immediately lay the print, face down, upon this, and squeeze out any air bells. The glasses are generally edged round inside with a rim of gold paint. The prints should be cut slightly smaller than the glasses, and be just large enough to cover the rim. Before the print dries a piece of waterproof paper is mounted over the back. Finally, the strut is affixed with glue.

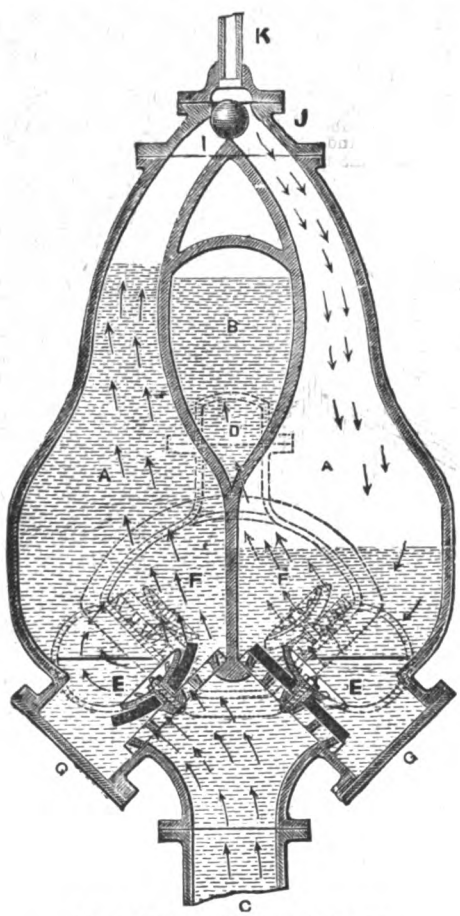
Air Pump for Blowlamp.—An air pump for a blowlamp, and particularly suitable for the apparatus described on p. 151, may be made from brass tube 1 in. in diameter and 6 in. long. Take a thick circular disc of brass of the same diameter as the tube, and drill a conical opening in the side, and also a cross channel to join it as at D; then braze the drilled disc on the end of the tube. File away the surplus spelter, and with emery and oil grind the conical opening true, so that when the metal ball shown is dropped in it will

Air Pump for Blowlamp.

completely close the passage. If any difficulty is experienced in making the ball fit air-tight, line the cone with thin leather; the ball will then act satisfactorily. C is a plug of leather well soaked in oil, and attached to the plunger rod by means of a small nut as shown. When in use, the back pressure exerted on the lower end of the plug causes it to expand on the down stroke, and so closely fit the tube that all the air in it is forced through the outlet D. On the upward stroke commencing the ball closes down the hole at D, and air passes the sides of the plunger as it is drawn upwards. A screwed cap B made to fit the barrel completes the pump.

Cementing Joints Round Cooking Ranges.—A cement that will not crumble and break away from joints in a cooking range and from around the front edges of range covings cannot be obtained. The heat appears to affect the cement, but the real cause is the expansion and contraction of the range parts when heating and cooling. A slow-setting cement might be used, so that when the fire is lighted the range parts and cement may accommodate themselves to each other. If care is taken to keep the joint very small common glaziers' putty could be used; this answers well, as it eventually hardens with the heat. But better still will be to have the stone jambs tight up or overlapping the edges of the covings; or provide a moulded edge up each side and across the top of the range to overlap the jambs and frieze.

The Pulsometer.—The illustration shows a sectional elevation of a pulsometer, which is an appliance for raising water by the alternate pressure and condensation of steam. To describe the parts, K is a pipe from a boiler containing steam under pressure. The gunmetal spherical valve is free to move and to alternately cover the necks I and J. The latter form the upper parts of the chambers A A, into which water passes through the valves E E from the suction pipe F. G G are doors for access to the valves E E for repairs or other attention. Near the bottom ends of A A are side outlets, as shown by the dotted circles, covered by the valves F F, also shown by dotted lines, opening into a chamber with which are connected the air vessel B and the outlet branch D, to which the delivery pipe is attached. The action is as follows. The pump is first charged with water through plug-holes



Sectional Elevation of Pulsometer.

provided for the purpose, and then steam is turned on at K. This presses on the water on the right hand chamber A (which is not covered by the spherical valve), and forces it, as shown by the arrows, through the right-hand valve F and up the delivery pipe. The steam in the right-hand chamber A then condenses, and causes the spherical valve to roll over and cover the neck J, and also creates a vacuum, which is again filled with water through the right-hand valve E from the suction pipe C. When the valve has rolled over J, the steam passes through the open neck I and presses on the water in the left-hand chamber A, forcing it through the dotted left-hand valve F into the delivery chamber. When the left-hand chamber A is nearly empty, the valve is again pulled back by the condensation of the steam in the chamber, which again fills with water during the time the other chamber is being emptied, and these actions continue as long as steam under efficient pressure is supplied. As water will not rise in a vacuum beyond a certain height, a pulsometer should not be fixed more than about 15 ft. or 20 ft. above the water to be raised, although theoretically the limit is a little more than 30 ft. The pump can be slung on chains in a well or sump, so that there is very little trouble in fixing it, or lowering it when necessary for keeping within a working distance of the water. The height to which a pulsometer will raise water depends on the pressure of steam in the boiler, which is used in conjunction with the apparatus.

Making Typewriter Inks.—One of the most popular recipes for ink for typewriter ribbons is as follows. Melt some petrolatum, having a high boiling point, on a water bath. Petrolatum is a soft hydrocarbon obtained from the residues left after the distillation of lighter oils from crude petroleum, or it may be deposited by the latter on standing; its commoner name is vaseline. Incorporate as much lampblack or powdered dropblack as the petrolatum will take up without becoming granular. When the mixture is partly cool, dissolve it, a little at a time, in a mixture of equal parts of petroleum, benzine, and rectified oil of turpentine. Regulate the quantity of the latter solvents to produce a solution of the consistency of fresh oil paint. Try on one end of the ribbon and, if too thin, add wax; if too faint, add colour; if too hard, add vaseline. Apply to the ribbon and brush off the excess. Many typewriter inks have glycerine, a very undesirable ingredient, as the vehicle for the colouring matter. The following recipes are typical of the composition of such inks. (1) Dissolve ½ oz. of aniline dye in 4 oz. of glycerine, and add 2 oz. of alcohol and 2 oz. of water. (2) Dissolve 1 part (by weight) of powdered aniline dye in 6 parts of glycerine, and add 3 parts of soft soap. Warm until the soap dissolves and well mix. (3) Dissolve ½ oz. of aniline dye in 15 fl. oz. of alcohol, and add 15 fl. oz. of glycerine. (4) A good ink is made by dissolving 1 part of aniline dye (soluble in oil) in 6 or 8 parts of oil of cloves; gentle heat assists the solution. The aniline dye in these four recipes may be of any suitable colour; black and violet are perhaps the most serviceable. Another method of making a black ink is to grind 1 part of gas black with 5 parts of oil of cloves. All inks containing aniline colouring matter and glycerine are copying inks. Two other recipes for copying inks are here given. (1) Grind 1 part (by weight) of suitable aniline colouring matter with 6 parts of glycerine. (2) Dissolve, by the aid of heat, 1 oz. of transparent soap in a mixture of 4 fl. oz. of glycerine and 12 fl. oz. of water; mix with a solution of a sufficient quantity of aniline dye in 24 fl. oz. of alcohol. If the ink is too thin, add soap. The unsatisfactory results given by home-made typewriter inks appear to be caused by the use of glycerine as one of the ingredients, according to Prof. Shuttleworth. The hygroscopic properties of glycerine make it an undesirable ingredient, and the addition of glucose, soap, alcohol, or water does not improve matters. Vaseline, with or without the addition of wax, gives better results, but its consistence is appreciably affected by temperature. Prof. Shuttleworth proposes castor oil as a more suitable medium; the colouring matter may be any of the salts of the aniline series, and of these methyl violet is practically soluble in the oil mentioned. In preparing the ink, triturate the powdered colour with the oil in the mortar, the work being facilitated by the addition of a very little alcohol A suitable formula for such an ink is that of Higgins. Castor oil, 4 oz.; carbolic acid, 1 oz.; oil of cassia, 1 oz.; suitable aniline colour, 1 oz. Printing inks may be modified for service in the typewriter by adding vaseline to make them non-drying on the ribbon; if it is found that they are too soft, add wax also.

Fog on Photographic Dry Plates.—If light reaches a dry plate by any other way than through the lens when the plate is exposed in the camera, the result is fog; that is, the sensitiveness of the plate is destroyed, and development produces black patches of greater or less intensity according to the amount of light that has accidentally fallen on the plate. This fog may be due to defective slides, to cracks in the camera, to leakages of outside light into the dark room, or to an unsafe lamp. In a score of other ways, all of which may be classed under careless or faulty handling of the plates during their journey from the maker's box to the developing dish, light may reach the sensitive plate and cause fog.

Lead-light Glazing.—As a cement for fixing lead lights to steel frames, the following preparation will probably give satisfaction. Mix liquid glue with a sufficient quantity of wood ashes to form a thick mass; the ashes should be added in small quantities to the glue (while boiling), and constantly stirred. A sort of mastic is then obtained, which, applied hot to the glass and metal, fixes the two firmly together. A good hard stopping can be made of fine litharge, 2 parts; white lead, 1 part; copal varnish, 1 part; boiled linseed oil, 3 parts; the whole is well triturated together. Lead glazing may be fixed in either wood or metal frames.

Making Triad Pictures.—A triad picture is simply three pictures in one; from a standpoint exactly in front of it a certain view, represented by X (Fig. 1), is seen. From a point a little to the right-hand side is seen a totally different view, represented by Y (Fig. 2); while movement to the left discloses a third picture Z (Fig. 3). The construction is very simple. First get three pictures and select the central one. For the purpose of description, suppose it to be 13 in. wide; the height is not material at present. On the back of the picture rule pencil lines, dividing it into thirteen divisions, each 1 in. wide, and mark these divisions $\frac{X}{1}$, $\frac{X}{2}$, $\frac{X}{3}$, and so on, as shown on Fig. 4. Next take the picture represented by Y (Fig. 2). Suppose it to be 12 in. wide; on the back rule pencil lines, dividing it into twelve divisions, and mark the divisions $\frac{Y}{1}$, $\frac{Y}{2}$, $\frac{Y}{3}$, and so on, as shown on Fig. 5. Space the third picture (also 12 in. wide) into twelve divisions, and mark each $\frac{Z}{1}$, $\frac{Z}{2}$, $\frac{Z}{3}$, etc., to Fig. 6. Next take a sheet of paper (lining wall paper will do), 37 in. long, and in width equal to the height of the pictures. Divide it into thirty-seven parts, and mark each $\frac{A}{1}$, $\frac{A}{2}$, $\frac{A}{3}$, etc. (Fig. 7). Now, with a very sharp knife cut off the central picture the slip marked $\frac{X}{1}$ (Fig. 4), and paste it on the division marked $\frac{A}{1}$ (Fig. 7). Next take the Z or left-hand picture and cut off the slip marked $\frac{Z}{1}$ (Fig. 6), and paste it on $\frac{A}{2}$ (Fig. 7). Then off the Y or right-hand picture cut the slip $\frac{Y}{1}$ (Fig. 5) and paste it on $\frac{A}{3}$ (Fig. 7). Now return to the X picture, and cut off the slip $\frac{X}{2}$ (Fig. 4) and paste it on $\frac{A}{4}$ (Fig. 7), and so on, until all the slips are pasted in the order shown on Fig. 8. Now fold the combined picture on a piece of millboard slightly larger than the central picture, paste down the first strip X^1 (Fig. 8), paste Z^1 and Y^1 back to back, secure X^2 close to the first strip, put Z^2 and Y^2 back to back, and so on (see Fig. 9). If the pictures are comparatively narrow, say 9 in. or less from top to bottom, do not cut

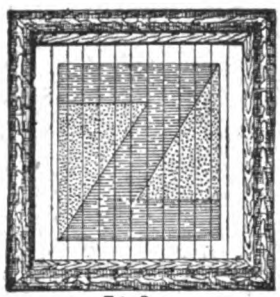


FIG. 3

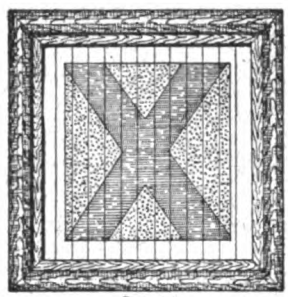


FIG. 1

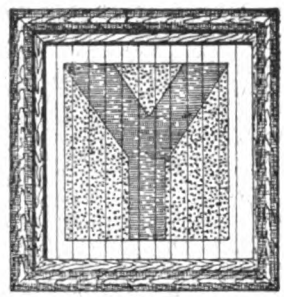


FIG. 2

FIG. 6

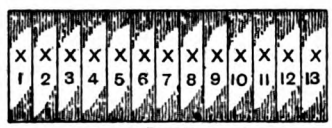


FIG. 4

FIG. 5

FIG. 7

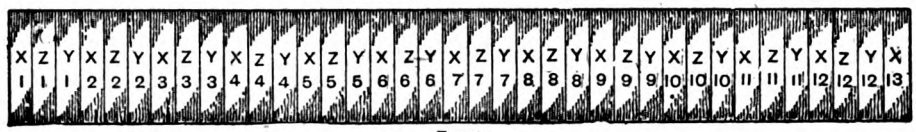


FIG. 8

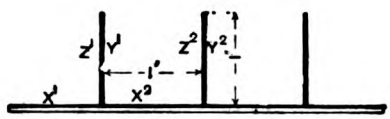


FIG. 9

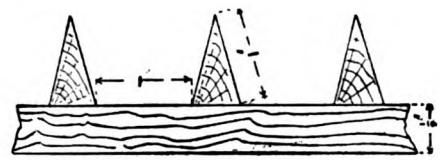


FIG. 10

Making Triad Pictures.

the centre one but paste it on a sheet of card, which should be 1 in. larger all round than the picture. Now glue a 1-in. by 1-in. wood slip, neatly mitred at the angles, round the edges of a sheet of stout millboard, make saw cuts ¼ in. long and 1 in. apart in the top and bottom pieces, and fix the frame round the picture. Paste the other pictures on paper having ¼-in. margins at the top and bottom. Cut them into 1-in. strips, paste corresponding strips back to back, run the brush along the proper edge of the connected strips, and fix the ends into the ¼-in. saw cuts. If the centre picture is wider than the others, the height of the upstanding strips will be less than the width of the centre picture strips; when uprights and flat strips are of equal width, as in Fig. 9, shadows are apt to interrupt the side views. Spaces as X^1 in Fig. 9, 1 in. wide, with uprights Y^2 ⅛ in. high will suit a centre picture 15 in. wide, and two others 10¼ in. wide, or one 10 in. wide, two 6⅞ in. wide, etc.; dimensions respectively of 1 in. and ¼ in. suit a centre picture 15 in., and two other 7 in.; and dimensions of ⅛ in. and ½ in. suit a centre picture 12 in., and two others 7½ in. Oleographs and photographic enlargements make good triad pictures. Triad signboards having worded announcements are made as in the section (Fig. 10) with wedge-shaped pieces having 1-in. sides and ½-in. base. Paint these same as ground, and put a letter in each division.

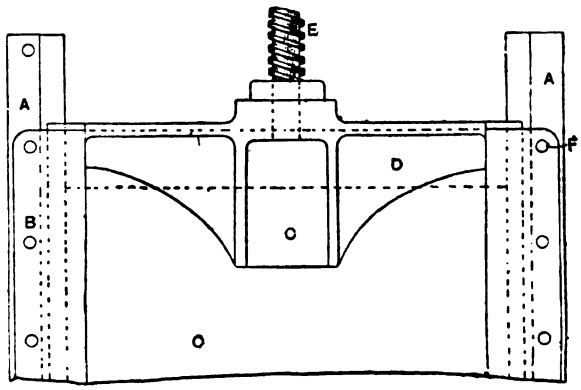
The Manufacture of Artificial Gems.—As early as 1837 Gaudin made artificial rubies by heating ammonia, alumina, and potash by means of an oxy-hydrogen blowpipe: the intense heat volatilised the potash and alumina, afterwards producing crystals in rhombohedral forms identical with those of the natural stone, and having the same specific gravity and hardness. Methods of producing crystals of corundum, ruby, sapphire, etc., were discovered about 1858, but both these and Gaudin's processes had but little commercial value, the great expense precluding their adoption. Until quite recently, the only artificial gems known to commerce were coloured glass, and, in some cases, wax preparations backed with silver or a mercury amalgam. Now, however, the chemist can produce imitations that, in lustre and hardness, equal the real or found gems; perhaps "imitation" is not the correct word, as the composition of both manufactured and found stones is supposed to be the same. Sometimes it is quite impossible to distinguish between the two kinds of gems, although generally examination under the microscope discloses some difference. As seen through a microscope, natural rubies contain minute cracks which indicate the lines of cleavage; the artificial gem shows very minute bubbles or gas holes. Analysis has proved that the sapphire is pure alumina, that is, oxide of aluminium (Al_2O_3). This is found in the form of a white powder fusible at high temperatures only. The colour of a sapphire is supposed to be due to the presence of chrome, and is dichroitic, that is, it varies with the point of observation; thus it is successfully imitated only with difficulty. M. Sidot, the French chemist, accidentally discovered a method of producing gems that possessed dichroitic properties. His method is to heat an iron pot to dark red and to place in it 4 oz. of superphosphate of lime; this is brought to the same heat and stirred with an iron rod, being then converted to crystallised pyrophosphate, which, on being further heated, becomes a fluid resembling molten glass. It is supposed that in this state a part of the phosphoric acid is changed to a tribasic phosphate. The fused mass is stirred continuously until it is quite transparent and free from bubbles, when it is transferred to another pot and kept at a white heat for two hours, the stirring being kept up all the time. After standing for an hour, it is poured on to a metallic surface and allowed to cool slowly until as soft as putty, when it is put on plate glass. When cold, a number of stones almost equal to the genuine sapphire may be cut from the plate. Another formula is: Smelt a mixture of 4 oz. of oxide of aluminium and 4 oz. of red lead (Pb_3O_4), and stir in 10 gr. of bichromate of potassium ($K_2Cr_2O_7$) and 17 gr. of oxide of cobaltum (CoO). When cold, stones may be cut that are as hard, if not quite so brilliant, as the genuine ones. The ruby, also, is oxide of aluminium coloured by chrome. Crystals of the rose-coloured ruby may be produced by melting together aluminium oxide and powdered silica, with the addition of fluoride of barium to form a flux, and then adding a trace of bichromate of potassium; 500 lb. of these ingredients, after perhaps a week's fusion, will produce rubies of 5 or 6 carats which may vary much in colour, running through all the shades of bluish sapphire and rose to the deep colour of the so-called pigeon-blood ruby. Ordinary borax fused with a little chromium oxide for a week or so produces large ruby crystals; but 200 lb. of ingredients may be required to obtain even two or three gems of any marketable value. One method of making artificial rubies is to smelt a mixture of 4 oz. of oxide of aluminium and 4 oz. of red lead, and add from 7 gr. to 16 gr. of bichromate of potassium. Natural emeralds are a combination of the rare element beryllium or glucinum with silicon; chrome gives the colour. Beryllium is too expensive for use in producing imitations, so oxide of aluminium is used, 4 oz. of this being smelted with 4 oz. of red lead, to which from 8 gr. to 12 gr. of uranate of sodium ($Na_2U_2O_7$) have been added. Hautefeuille & Perry, the French chemists, produce some beautiful emerald crystals by fusing silica, alumina, glucina, and a trace of chromium oxide with acid molybdate of lithia. After a fusion of fifteen days some very small crystals, having all the mineralogical and physical characters of the natural emerald, may be obtained. The longer the fusion the larger are the crystals. Emeralds and other gems have been produced from gas retort refuse by a method discovered by Mr. Greville Williams, F.R.S., who modelled an emerald composed of from 67 to 68 per cent. of silica, 15 to 18 per cent. of alumina, 12 to 14 per cent. of glucina, and traces of magnesia, carbon, and carbonate of lime. The colour was an intense green, due, it is believed, to the presence of sesquioxide of chromium. Imitations of the amethyst, topaz, etc., have been made very successfully by Donault Wieland, of Paris, whose method of preparing "Parisian diamonds" or "Alaska diamonds" is to smelt a mixture of 65 per cent. of pulverised crystal quartz, 20 per cent. of red lead, 8 per cent. of pure carbonate of potash, 5 per cent. of boric acid, and 2 per cent. of white arsenic. The brilliancy of the resultant stone depends principally on the purity of the red lead and of the carbonate of soda.

Principles of Sewing Machines.—The principle of the lockstitch sewing machine is, roughly speaking, as follows. The needle descends to the bottom of its stroke, and simultaneously the shuttle slides, vibrates, or oscillates as far as the end of its backward movement. Continuing the movement of the balance wheel, the needle begins to rise, and the shuttle immediately after begins to move forward. As the needle rises the material through which it is passing holds the needle cotton long enough to cause it to loop out behind the eye of the needle under the needle-plate. The shuttle, still moving forward, enters this loop and passes through it, the necessary amount of slack cotton being supplied either by the "time" of the needle-bar or by the check or take-up lever, according to the style of the machine. By the "time" of the needle-bar is meant the movement which is caused by a cam on the bar, causing it to descend the second time after it has risen sufficiently to throw out its loop and to allow the shuttle point to enter it. This descent throws off enough slack cotton to pass over the body of the shuttle without causing any strain on the cotton, and as soon as the shuttle has passed through the loop the needle-bar rises to its highest point and draws up the cotton into the material being sewn and the bottom or shuttle cotton with it, completing its stitch. Under the material and under the needle-plate is a feed dog which rises just before the needle has reached its highest point, and, moving back, carries the material with it the required distance and sinks below the needle-plate before the needle enters the work again. If the machine is a rotary hook machine, the hook, instead of sliding or oscillating backwards, continues to revolve, and is so arranged that when the needle is at the lowest part of its movement, the point of the hook is a little behind it, generally about $\frac{1}{16}$ in., a little more or less according to the style of the machine. The main points to remember are: (*a*) Short groove of needle is always toward the shuttle or hook. (*b*) When the needle is rising and the point of the shuttle is just level with it, the eye of the needle must be $\frac{1}{16}$ in. or more below the shuttle point. (*c*) The shuttle must not start to come forward before the needle begins to rise. (*d*) The feed must carry the material while the needle is well out of the work. (*e*) See that the shuttle point is sharp, and that the shuttle driver wherever it touches the shuttle is perfectly smooth, and that all points over which the cotton runs are also smooth. The movements of chainstitch machines are similar generally to the rotary hook lockstitch machine, but the hook having picked up the needle cotton does not drop or allow it to slip off until it has picked the second needle loop. It is very essential in chainstitch machines to have the right make of needles, as poor needles cause endless trouble. The short groove of the needle is again nearest the hook, and the hook should pass as near the needle as possible without touching. See that the hook is perfectly smooth, and in putting together such machines do not alter in the slightest the shape of this hook.

Removing Rust Marks from Wood.—In re-painting wooden structures disfigured by the marks caused by iron nails having turned rusty, first rub out the rust marks with sandpaper, getting as much rust as possible off the nail heads; then with a small brush worn down to a stump rub well in around each nail head some good oil varnish. When quite dry, apply the paint. The above method will check the rust to a great extent, but it will still form in the holes against the wood.

Testing Gravel for Gold.—In testing a hard rocky gravel for gold, first finely powder a sample of the gravel, moisten it in a tall cylinder with water, and pass chlorine gas through it, whereby soluble chloride of gold is formed. After treating with chlorine the gravel should be washed with hot water, the solution collected in a dish, boiled to expel the chlorine, and then heated with solution of ferrous sulphate. If gold is present it will separate as a fine brown powder. Another method is to take, say, ½ lb. of the powdered gravel, mix it with litharge (oxide of lead) and flour or cream of tartar, and heat it in a crucible in a furnace. The litharge is reduced by the flour or cream of tartar forming metallic lead, which melts and, as it passes through the gravel, takes the gold with it to the bottom of the crucible. After heating, the crucible is broken open and the button of metallic lead is removed. It is first roasted in a dish in a muffle furnace to get rid of the greater portion of the lead as oxide; the oxidation is then finished on a bone-ash cupel, which absorbs the oxide of lead formed, leaving, at the end of the operation, a button of metallic gold, providing that metal was present in the gravel.

Water-tight Sliding Door.—The opening to which a sliding water-tight door is to be fitted in a ship should have an angle iron all round at the edges of the plate to stiffen up the plating. This angle is on the side of the plate opposite the door. The sketch shows the general construction of a sliding watertight door at the end which takes the screw for sliding the door open. A and D are the sides and top of the cast-iron frame which forms the bed for the door to slide on. B shows pieces of plate, generally about 3 in. broad, which form the back sliding surface. The door itself (C) is a casting. Across the centre and bottom of this is a web, as well as that shown at the top. These webs are solely for stiffening the door. A hole is made through at the centre to allow the door to travel up the screw when the door is being opened. The centre of the screw is usually kept about 6 in. from the bulkhead, and it and the gearing rods are supported by cast-iron brackets. When the gearing has to be angled, bevel wheels are used about 6 in. in diameter, with thirty teeth of ½-in. pitch. The gearing rods are usually about 1¼ in. in diameter.

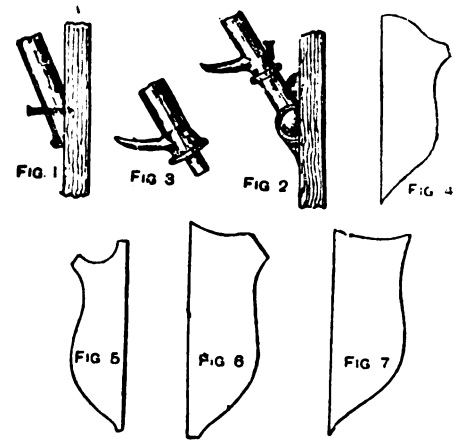


Water-tight Sliding Door.

Proportions for a Compensation Pendulum.—A zinc and steel compensation pendulum for a regulator clock having a dead-beat escapement is of fairly simple construction. For a seconds pendulum the central rod is of steel, ⅛ in. thick, and measures 45 in. from the bottom of the thread for the rating nut to the point of suspension. Over this rod, and resting on the rating nut, is a zinc tube 26 in. long and from ½ in. to ⅝ in. thick. This tube slides freely over the rod. Outside the zinc tube, and depending from its top end, is an outer steel tube (bicycle tube) 23 in. long. At its lower end an outside collar is fixed, on which the bob rests. This is of lead, cast with a central hole having a shoulder in its centre. The upper part of the hole just frees the steel tube, and the shoulder rests on the collar. The lower part of the hole is large enough to clear the collar. Thus the bob is supported at its centre and expands as much up as down. Its length is 9 in. and its shape cylindrical. For a 14-lb. bob 2½ in. diameter will be suitable; for a 17-lb. bob 2¾ in. will do.

Laying Tar Footpaths.—Tar footpaths are inexpensive as compared with flagging, etc., and if properly laid, water will not soak into them, nor will the heat of the sun melt the tar. It is laid in two layers—the bottoming and the topping. The bottoming, which is composed of slag, clinkers, etc., is mixed with a hot composition of gas-tar boiled in a cauldron, a little pitch and resin being added. Before being used, the materials must be allowed time to become thoroughly incorporated with the tar. The formation level being ready, a thickness of 2 in. of this bottoming is laid and well rolled. The top layer, 1 in. in thickness, is now laid on this and well rolled. The topping differs from the bottoming only in the smaller and finer quality of the materials which, in the case of topping, are mixed with the tar. The surface is now flooded with the tar composition in a boiling condition, and, whilst wet, is blinded with clean white sand or fine granite dust. A footpath of this kind lasts a long time without requiring any repairs worth mentioning. Inequalities and bad patches must be cut out as soon as they occur, and new material well rammed in. Every two or three years, according to the character and extent of the traffic, a fresh top should be laid over and blinded. These footpaths will, however, last usually six or seven years without requiring absolute renewal.

Cleaning and Mounting Antlers.—Below are given instructions on cleaning and mounting a pair of stag's antlers. Well wash and scrub the antlers with warm water and soap. Thoroughly dry them with a cloth or towel, then give another smart rubbing with a perfectly dry cloth to remove some of the dulness from the sharp edges and prominences. The antlers can be mounted by one of the following methods. Fig. 1 shows how, by cutting a piece off the back of the antler, it may be fixed to the mount by means of a screw passing through a hole previously drilled in the antler. Fig. 2 shows an artificial forehead of wood, with short processes or projections upon which the antlers rest, being screwed from the back. Another method is to drill a large hole lengthwise into the antler from the base, and in this hole to place a dowel (see Fig. 3), by means of which the antler may be fixed as in Figs. 1 or 2. Designs of shields or mounts are shown by Figs. 4 to 7. To make these, double a piece of paper, draw half the shield as shown, and cut out through both pieces of paper. Flatten out the paper and mark round on the wood with a pencil. The mounts can be made of oak, mahogany, or walnut, the first-named for preference. Ebony or ebonised wood is rather too gloomy, though often used.



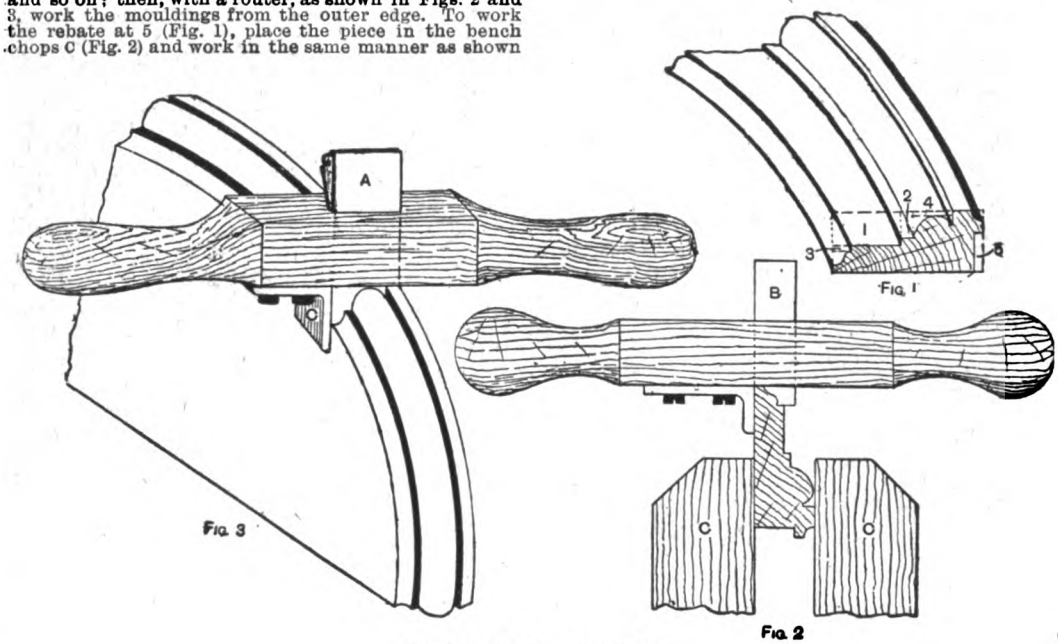
Cleaning and Mounting Antlers.

Gilding Steel Pins.—Highly polished steel pins, free from grease and oil, may be gilded in an electro-gilding solution of gold cyanide. When a quantity of pins is required, they may be gilded in dozens at a time if suspended in the solution in a basket of platinum gauze, which must be shaken whilst the gilding process is going on. Any gold deposited on the platinum may be afterwards dissolved off in the gilding solution without doing it any injury. The pins are scratch-brushed and polished in the usual manner. This method is applicable to all small steel articles.

Varnish for Walnut Gunstock.—A walnut gunstock may be coated with a very bright varnish made according to the following recipe. Take 4 oz. of best orange shellac, 4 oz. of gum sandarach, 2 oz. of gum benzoin, 1 oz. of Venice turpentine, one pennyworth of camphor, and 1 pt. of methylated spirit frequently agitate, and carefully strain through muslin. The varnish should be applied with a camel-hair brush in a warm room.

How to Make Photographic Silhouettes. — In making photographic silhouettes, as the exposure required is so much less than that necessary for an ordinary portrait, a slow lens can be used. Stretch a sheet across an open doorway where it can be well illuminated from without, and set the camera up in the room, the figure being close against the sheet. Remove from the room any articles likely to throw light on the figure, which should be dressed in black, and focus the dark outline shown on the sheet. A brief exposure must be given, as it is necessary to expose for the sheet only; backed plates must be used to prevent halation, that is, a spreading of light around the edges of the shadow due to the light reflected from the back of the dry plate. Magnesium light is particularly suitable for this work. When the feet are to be included, the figure must be supported upon plate glass covered with thin muslin.

Working Circular Mouldings.—Fig. 1 shows a piece of circular moulding worked on the flat surface. First cut out the required shape or plan; get the piece equal in thickness and parallel in width. Sink squares as shown by dotted lines, taking out No. 1 square first, and so on; then, with a router, as shown in Figs. 2 and 3, work the mouldings from the outer edge. To work the rebate at 5 (Fig. 1), place the piece in the bench chops C (Fig. 2) and work in the same manner as shown



Working Circular Mouldings.

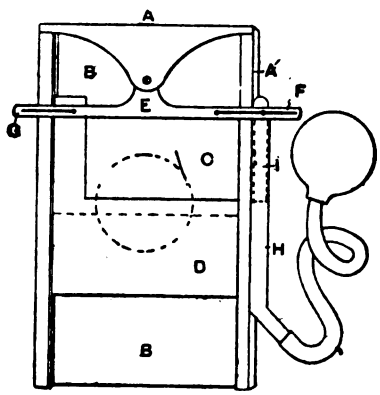
for the small member on the inner edge. Fig. 3 shows how the moulding may be worked on the edge of a shelf bracket. The router can be bought at a toolshop, or made with a piece of hardwood and a piece of $\frac{1}{16}$-in. thick steel. B (Fig. 2) and A (Fig. 3) show the cutter. The fence C (Fig. 3) may be either of brass or iron slotted so as to be adjusted.

Preparation of Skins for Glove Making.—"Kid" gloves are made chiefly from lamb and kid skins, which have to pass through many processes, such as washing, hairing, paddling, tanning, staking, colouring, and polishing. First the skins, each about 4 ft. long and 3 ft. wide, are soaked for one or two days in cold water contained in wooden vats; the soaking tubs each contain about 600 skins. The latter pass to a circular drum having a horizontal axle, a diameter of about 8 ft., a width of about 4 ft., and making about one revolution per second. Wooden pins projecting into the interior of the drum keep the skins in motion, so that a continuous stream of water thoroughly saturates the skins and frees them from dirt. At the end of fifteen minutes the skins are removed to the lime pits, which may be about 8 ft. long, 5 ft. wide, and 8 ft. deep, and capable of holding many hundreds of skins. The lime and water loosen the hairs, and at the end of a fortnight the skins are taken out with long-handled tongs, and the excess of lime is removed by placing them in cold water and running them backwards and forwards over a paddle wheel, 3 ft. in diameter, 6 ft. long, and making forty revolutions per minute. After this paddling, the skins are spread over an oval-shaped wooden bench, and the hair is scraped off with a tool resembling a carpenter's draw-knife. A similar bench is used in fleshing —the next operation—in which all particles of flesh are cut off, the skin is given an even thickness, and the ragged ends are trimmed. After being washed in the revolving drum for thirty minutes, they are again fleshed to remove the grease, paddled in warm water, spread out on benches, and slated to remove surplus dirt. After again being paddled, the skins are drenched in a tub of bran and water, being paddled in the drench for twelve hours; this removes the last traces of lime and opens the pores preparatory to tanning. The latter operation is performed in a revolving drum, the tanning liquor being a mixture of alum, salt, flour, yolks of eggs, and water. The drum makes eighty revolutions per minute, and at the end of twelve hours the skins are removed and hung up for twenty-four hours in the drying-room, heated to a temperature of 110° F. The dry skins are damped with water and softened in a mill, consisting of two perpendicular swinging planks, having heavy wooden blocks at their lower ends; in front of these blocks the skins are placed and squeezed and pressed together until soft. The next operation is staking, performed by drawing the skins over a knife-edge. After a little time in the drying-room, the skins are again staked, this staking tending to soften the skins and to remove the dried flour left from the tanning. After ripening for a few months, the skins may be dyed, being first washed in a drum of cold water for twenty minutes and then placed for twenty-four hours in a revolving bath of egg-yolk, which softens the skins and makes them pliable. In colouring, the skins are slicked out smooth on a lead-covered table and washed with potassium bichromate and soda. The dye is then poured on and rubbed in with a brush. Iron sulphate is used for black, zinc sulphate for drab, and sulphate of alum for tan. After dyeing and staking, the skins are finished by polishing on a flannel-covered wheel. The tanned skins are made up into gloves as described on p. 286.

Polishing Paste for Brown Boots.—A good polishing paste for brown boots can be made with 20 fluid oz. of good malt vinegar, 10 fluid oz. of filtered water, 2 oz. of good glue, 1 dr. of soft soap, and 1 dr. of isinglass. Colour with annatto or turmeric to the shade required. First mix the water and vinegar, then dissolve the glue in the fluid by gently heating it; add colouring and other ingredients, and boil from ten to fifteen minutes. When the mixture has been strained thoroughly, it is stored in jars until required for use. To use this composition, lay it on with a clean sponge, and polish with a soft rag or flannel.

Tools for Engraving Letters.—Generally speaking, the shank or some other portion of a letter is engraved with a flat tool and finished with a lozenge graver whetted at three angles. Block lettering is wholly cut with a flat tool. Old English is cut with two flat tools of different widths, and finished with an angle graver, as above. This is the reason that the work looks regular and of equal size throughout, and is kept straight by working between parallel lines. To make a flat tool for lettering, whet each side of the belly or underside of a lozenge graver at an acute angle, the sharper the better, and then rub away the angle thus formed until a flat is formed of a width suitable for the letters to be cut; then sharpen as from the back as usual. A very moderate set-off or bevel is required for flat work, as if the bevel is too great it will cause the tool to slip over the boundary lines, and consequently spoil the work. Before attempting engraving on articles of value considerable practice should be had on a plate of German silver or sheet brass. For drawing outlines, the only instrument used is the steel tracing point or etching needle.

Construction of Camera Shutter.—A camera shutter similar in working to the unicum is made as follows. Construct a grooved framework A consisting of a board B with an opening for flange and grooved rails A'. Cut two blades in ebonite, C and D. The lever E, with slots F and G, is made in thin metal. Fasten to A' a cylinder made from a piece of brass tube H, having a well-fitting piston-rod I. (A

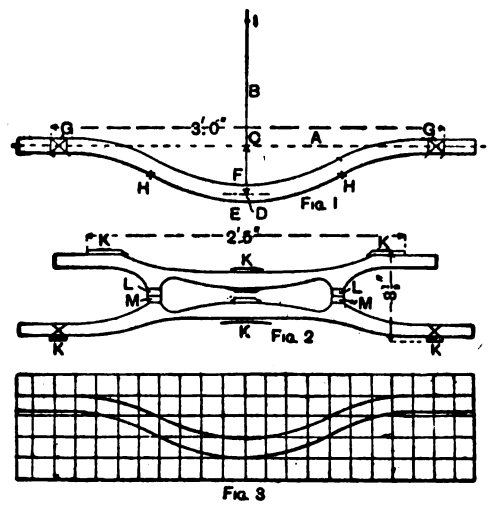


Construction of Camera Shutter.

simple substitute may be made easily by winding some paper tightly around a piece of knitting needle.) Two small rivets, fastened to the blades C and D, pass through the slots F and G, so that when the piston-rod that is attached to E is forced upwards C is raised and D depressed, thus opening the lens. The return of the rod is caused by the suction due to the release of the press ball.

Polishing Painted Furniture.—Before painted furniture can be French polished, the paint must be removed; do this as explained on p. 237. Should the furniture have been finished out with enamel paint or varnish with a spirit basis instead of paint, strong soda water, or a solution of hot borax and rock ammonia, should be used; or, if the lime is objected to, try the following. ½lb. of American potash, ½lb. of soft soap, ½lb. of rock ammonia, 1lb. of washing soda, and 1 gal. of water. The outer coverings of the upholstering should have been removed before commencing, and they should not be replaced till the polishing is completed. If the furniture is of mahogany, it should now be a dark colour, which only needs wiping over with red oil, made as on p. 41, and a trace of red in the polish to ensure a rich dark mahogany or Chippendale colour. A red colour is imparted to the polish by adding one pennyworth of Bismarck brown to each pint. In French polishing, a pad of wadding enclosed in fine rag is used. Saturate the wadding, cover it with the rag, and draw it up tightly till it presents a face free from creases. The pad should then be applied with continuous, uniform, circular strokes with slight pressure at first, recharging the pad with fresh polish at frequent intervals, taking care that every portion of the wood receives an equal but not excessive body of polish. A few spots of linseed oil should be occasionally applied to the face of the pad to prevent it sticking. If the surface of the furniture is uneven, it is impossible for an inexperienced worker to finish it out perfectly bright with polish only. When the furniture appears uniform in colour, and the grain is filled up, it should be finished by the application of at least two coats of best quality brown hard spirit varnish.

Pattern for Compassed Bed of Under-carriage.—Below is described one way of marking out a pattern for the compassed bed of an under-carriage. As an example, Fig. 1, which represents an ordinary compassed bottom bed of a brougham under-carriage, is given. To set it out, draw the straight line A (Fig. 1); square off a line B, and from C mark off the compass 4½ in. to D, which is the centre of the bed. From D, mark off the width of the bed back and front, as E F. At G and G, which are the spring bearings, on each side of the centre line mark off distances equal to the width of the bed; this is governed by the wheel-iron head. Mark off the size of the wheel plate, as at H H, cutting these points by half the width of the compass of the bed; then, using I on the square line as centre, strike a true line to the points D and H H. With the same radius, continue the sweep towards the end until it meets the square line, which should be about 1 in. inside the spring bearing G. With the compasses of the same radius, describe the inner line of the pattern. Fig. 2 shows the elevation of the beds when together, and the method of sweeping them out. The parts K represent the top and bottom bed plates, L the



Setting Out Pattern for Compassed Bed of Under-carriage.

wheel plate, and M the transom plate; the beds are left straight in the centre until the top and bottom plates are fitted, these being screwed on temporarily. The beds must be swept out as shown, care being taken to leave intact the bearings for the wheel plate and transom plate. In testing a carriage for truth, the tools used generally are a straightedge, square board, and wax line. If these do not give a sufficiently exact result, draw a diagram as Fig. 3, setting the squares off perfectly true, when any error can be quickly seen.

Jointing Electric Wires.—In jointing up seven-strand electric cables, the insulating covering is removed for several inches from each of the two ends to be joined, and the copper surfaces are scraped absolutely clean. They should be touched as little as possible by the hands to prevent any moisture reaching them. Tinned wire is preferable. Care must be taken that nicks are not made in the strands while the insulator is being removed, since such nicks decrease the sectional area of the wire to a considerable extent. The wires are then taken and opened out, the two sets being placed together and interlinked, the central strand of a seven-strand cable being cut off short to allow this to be done. The ends are then well wrapped round each other, and trimmed over fairly smooth with pliers. Using resin as a flux, and taking care throughout the whole operation that everything is clean, the whole is then well soldered. The insulation on the cable will determine whether strips of pure rubber or of gutta-percha should be then wound round the joint. The latter should be warmed by a spirit-lamp and well kneaded by thumb and fingers. After several layers of this strip have been applied, the whole is wound round with specially prepared tape.

Hints on Choosing a Dwelling-house.—In ascertaining whether a house is a desirable dwelling place, first examine the walls of the house, and if settlements or cracks are discernible, it is more than likely that the foundations are faulty; these should be bared and examined. Renewing or underpinning a foundation is a very expensive operation. When any serious settlement takes place, stone heads of windows show defects as soon as any part of the building. If the external walls of the house are built of rubble stone or brickwork, see that the mortar is of good quality; a simple test is to rub it between the finger and thumb, when, if it crumbles into dust, the work will require to be repointed in a short time to prevent moisture penetrating. If the house is covered with slates, see that zinc soakers are placed against the party walls. If it is covered with tiles, see that cement fillets instead of mortar fillets are used. In the selection of a cottage the sanitary arrangements are the object of most importance. It is essential, before purchasing, to have the drains tested by an expert. Never have a dustbin built against the wall of the house; the contents of the dustbin will saturate the wall and contaminate the air of the interior. The damp course should be in accordance with the requirements expressed on p. 259, and must not be made of tarred felt material. Find out whether a proper circulation of air exists under the ground-floor joists, to prevent dry rot. If there is a drinking-water cistern, see that it does not directly supply a water-closet, and that the overflow from the cistern does not directly connect with the drain. The soil pipe should never be placed inside the house, because if it is defective in its original construction, or if it be subsequently damaged, a serious leakage of foul air takes place. The water-closet should have direct light and ventilation. The long hopper pan should be objected to, because it always becomes filthy. The sink should be in a well-lighted position and always against an external wall. See that none of the rain-water pipes have any connection with the soil pipes. As to the interior, see that the doors fit and are out of winding; observe the framing and see whether the shoulders are off—that would be an indication of unseasoned wood having been used. Look to the hinges; there may be only a screw or two in each hinge. Try the locks and see that the furniture is fixed on securely. Examine the windows to see whether the sashes are too loose; if so, have the rattling remedied.

Repairing Worn Watch Pivot Holes.—It is not necessary to plug and re-drill watch pivot holes when they are worn. Purchase some watch bouchons. These are brass pins, turned true and drilled accurately to centre. Select one that will nearly go on the pivot. Put it in a pin vice, and very slightly file it tapered. Then open out the pivot hole with a broach until the bouchon can be hammered in tight and broken off. File it level with the plate, and smooth off by stoning. Then open it out to fit the pivot. This method leaves the depth unaltered.

Waterproofing Fabrics.—Woven fabrics may be rendered waterproof in a variety of ways, one of the commonest methods being to apply a coating of rubber solution and then to vulcanise the film of rubber remaining after the evaporation of the solvent. By the waterproofing method of Hime & Node, zinc is added to a solution of cellulose in an ammoniacal copper solution; copper is precipitated, and the fabric to be proofed is immersed in the remaining colourless viscid solution of ammonium, zincate, and cellulose. The impregnated fabric is pressed, dried, and wet-calendered, that is, passed between rollers. By another method, a fabric having a close texture is treated with sulphuric acid (115° Tw.), the fibres being partly parchmentised thereby, and the interstices closed without the texture of the cloth being in any way injured. The excess of acid is washed out, with or without previous treatment with alkali, and the fabric is passed between calendering rolls, which complete the closing of the interstices. Holfert's process is to pass the fabric through a bath of gelatine and then expose it to the action of gaseous formaldehyde, the gelatine becoming insoluble. Another method of treatment is to apply to the fabrics boiled linseed oil, paints, varnishes, asphaltum, etc., as in the production of oilskin, tarpaulin, etc. (see p. 69). But one of the best of the waterproofing processes is explained below, in which the fabric is treated with an alumina soap. The word "soap" refers generally to a material used in removing dirt, and this it does by attacking grease and by removing the harshness or "hardness" of the water in use. But there are soaps which are insoluble in or quite incompatible with water, and these have their use in rendering fabrics waterproof. The ordinary soap of commerce is in one of two classes—"hard" or "soft"—and is formed by boiling fats with alkalis. With soda as the alkali a hard soap results, with potash a soft soap, these products being the alkaline salts of certain fatty acids—oleic, palmitic, stearic, etc.—derived from the fats used. When a solution of the salt of any other metal is added to a solution of either of the above soaps, a precipitate of an insoluble soap of that metal is formed, because all but the alkaline soaps are insoluble in water. In this manner it is possible to produce soaps of lead, copper, iron, aluminium, etc. Alumina soap, so largely used in waterproofing, is formed from alum and soap in the manner above described. In waterproofing fabrics with an alumina soap, one of two different methods may be employed. For the first method two solutions are required. (1) 1 lb. of alum in 1 gal. of boiling water; (2) 1 lb. of ordinary soap in 1 gal. of boiling water. Keep these solutions in separate tubs or troughs. The best soaps to use are palm-oil or white-curd soap, but common yellow soap answers very well. The soap must be dissolved entirely or the coating will be patchy. When the solutions have cooled slightly, but while they are still warm, the cloth to be waterproofed should be immersed in the soap bath for about fifteen minutes, so that the soap sinks into the fibre. The cloth previously should have been soaked in water and wrung out. After wringing out the excess of soap solution, immediately plunge the cloth into the alum bath, in which it may remain for an equal period, and, being removed, excess of alum solution may be wrung out also. If a thick coating of the alumina soap is required, the cloth may be put through this treatment two or three times, and, after steeping in clean water, it may be hung out to dry. The cloth on drying will be rather stiff and white, and somewhat rough, but will be quite waterproof; if the roughness is objected to, pass over the surface a hot iron, or calender the cloth between rollers. Any kind of cloth may be treated by this method, but the most suitable kinds are those that are closely woven, no matter how coarse the fibre is. Fabrics waterproofed in this way are but little altered; their feel is, however, somewhat harsh, and water poured over them will run off without wetting any part, the alumina soap having filled up all the interstices, and formed over the fibres a protective coat, which prevents the water touching the cloth. The second method of applying the alumina soap is in the form of a solution in petroleum ether. The alumina soap is formed by mixing together the boiling alum and soap solutions as previously prepared; for complete precipitation 2¼ lb. of soap will be required to every 1 lb. of alum. The alumina soap separates out as a large cake, which should be collected on a piece of cloth, and the water squeezed out. The cake may be broken up into small pieces, thoroughly dried at a low temperature, put into a dry, wide-mouthed bottle, and covered with petroleum spirit (benzoline); paraffin oil is unsuitable, because it forms an unmanageable stringy mass. As the soap absorbs the benzoline it swells and should be stirred from time to time so that it is mixed thoroughly. The paste thus formed may be diluted as required with benzoline, but care should be taken not to add too much of it at any one time, because on standing the mass becomes unaccountably fluid, and possibly too thin; if this should occur, a little of the alumina soap is added. The waterproofing solution made in this manner may be laid on the cloth with a brush or, better, by passing the material through rollers fed with the solution. After treatment, the cloth should be hung out for a short time in the open air to allow the benzoline to evaporate. If a thicker dressing is required, the cloth may be coated two or three times; for ordinary purposes, however, once is quite enough. The alumina soap may be coloured reddish-brown by the addition of a little perchloride of iron in place of some of the alum, and green by the addition of sulphate of copper (blue vitriol). It is also possible to obtain other colours by employing solutions of other metals, but these are more or less expensive. The common colours, yellow and black, may be imparted by stirring in yellow ochre or lampblack with the soap solution in the first method, or by kneading it with the alumina soap in the second.

Carrying Camera on Cycle.—The best way of carrying a camera on a cycle is a much-debated question. The slides may be carried knapsack fashion on the back of the rider, the stand across the top bar of the frame, and the camera slung in a case over the back wheel. On a long journey, however, it is uncomfortable to carry anything on the back. If the apparatus is carried on the handle-bar the vibration is very great, and shutters, etc., soon get out of order; dust also readily accumulates. The dust trouble, however, may be easily overcome by carrying the camera and slides in dust-proof or close-fitting cases, and where the springs in the dark slides do not keep the plates tightly in position, a piece of rubber tubing put between one of the plates and the backing card will often overcome any vibration. But anything bulky on the handle-bar is liable to affect the steering, and increases the danger of side slip, while anything carried within the frame of the machine may make the pedalling very uncomfortable.

Killing Butterflies.—To kill, pinch them under the wings between the finger and thumb, or, for a collection, procure a "killing bottle," which may be bought from most naturalists, or may be home-made. Get a wide-mouthed bottle, provided with a good cork or glass stopper, and into this put an ounce (for a 4-oz. bottle) of cyanide of potassium in lumps. Then mix up some plaster-of-Paris, and pour this upon the cyanide, so as to cover it completely. Give the bottle a shake as the plaster is setting, so that it forms an even surface, and, when quite set, cover the plaster with a piece of blotting-paper to absorb the moisture and to keep the insect from contact with the damp plaster. This blotting-paper should be renewed when necessary. The cyanide is a deadly poison, so must be used with care, and the bottle kept corked. Put the insect into the bottle, cork it up, and leave the insect in for about ten or fifteen minutes. A few drops of strong spirit of ammonia poured on a piece of cotton-wool in a bottle will also form a killing bottle. Bruised laurel leaves may also be put into a bottle, and prussic acid will be given off, thus forming another killing bottle. A few drops of chloroform poured upon blotting-paper at the bottom of a bottle will also stupefy the insects to death. Nothing is required to preserve butterflies.

British Association Screw-threads.—The following table gives particulars of the Swiss small screw gauge as adopted by the British Association:—

No.	*Diameter (approximate) in Inches.*	*Pitch in Inches.*	*Diameter in Millimetres.*	*Pitch in Millimetres.*	*Threads per Inch.*
25	·01	·0028	·25	·072	353
24	·011	·0031	·29	·08	317
23	·013	·0035	·33	·089	285
22	·015	·0039	·37	·098	259
21	·017	·0043	·42	·11	231
20	·019	·0047	·48	·12	212
19	·021	·0055	·54	·14	181
18	·024	·0059	·62	·15	169
17	·027	·0067	·7	·17	149
16	·031	·0075	·79	·19	134
15	·035	·0083	·9	·21	121
14	·039	·0091	1	·23	110
13	·044	·0098	1·2	·25	101
12	·051	·011	1·3	·28	90·7
11	·059	·0122	1·5	·31	81·9
10	·067	·0138	1·7	·35	72·6
9	·075	·0154	1·9	·39	65·1
8	·086	·0169	2·2	·43	59·1
7	·098	·0189	2·5	·48	52·9
6	·11	·0209	2·8	·53	47·9
5	·126	·0232	3·2	·59	43
4	·142	·026	3·6	·66	38·5
3	·161	·0287	4·1	·73	34·8
2	·185	·0319	4·7	·81	31·4
1	·209	·0354	5·3	·9	28·2
0	·236	·0394	6	1	25·4

Double-action Harp.—The action is complicated, and unless it works with the greatest accuracy it is worse than useless. Briefly, the principle consists in placing beneath the wrest-pin a small collar having two studs fastened on its "flat" similar to a "wing-nut," the whole working on a stud through the head. These are connected by a system of levers in head and pillar to the pedals, pressure upon which causes a partial revolution of these collars, between the studs of which the string passes, and is consequently tightened or raised in pitch. Various pedals are required; for instance, one for F sharps, another for C sharps, and so on, each pedal affecting only the notes of the same name throughout the instrument.

Laying Red Tar-paving.—A very dull red tint may be obtained by using crushed red granite instead of limestone. The objection is that each particle of granite has a smooth surface, and the tar does not adhere satisfactorily. The cost will be from 1s. 10d. to 2s. 3d. per superficial yard. Another method is to dye the limestone with red oxide of iron ground very fine. The ordinary method of laying may be adopted, and the cost will be from 1s. 6d. to 2s. per square yard.

Toughening Paper.—Soak ordinary unsized paper in sulphuric acid (2 parts of acid to 1 part of water) for a few minutes, then thoroughly wash it with water containing a little ammonia until no trace of acid remains, and let it dry. This is "parchment" paper, and it is not much less pliable than the untreated kind.

Straightening Warped Fretwork.—The warping or twisting of fretwork is ofttimes counteracted by the use of three-ply wood—that is, three pieces of very thin board or veneer glued together the middle one being transverse to the others. Warping is often caused by excessive polish being applied to one side only, without a coat of varnish on the back to counteract. Nothing can afterwards be done, except to take the brackets apart and slightly damp them with clean water; screw them down between two stout boards till straight, then apply polish or varnish on both sides. There will still be the tendency to twist back again if the brackets are put in a hot place.

Bending and Fitting Ribs for Small Boat.—Use straight-grained American elm or oak, the former for preference. After being shaped and dressed, the ribs are steamed or soaked in boiling water till pliable, and bent over the knee where necessary. The ribs on either side are notched to fit over the keelson, and butt against each other where they cannot be carried right across. The keelson must not be cut; the ribs are usually spaced closer in the bow to add strength. Floor ribs extending on either side of the keelson and between the others are also notched and fitted over the keelson. A fore and aft stringer on either side is then screwed to both sets of ribs, which bind the whole together.

Cementing Felt to Iron Rollers.—To make a cement, cover glue with moderately strong acetic acid instead of with water, and treat it as for ordinary glue. Another cement is made by dissolving 2 parts of shellac and 1 part of Venice turpentine in 7 parts of methylated spirit. For a firm hold the cylinders should not be quite smooth.

Electric Current Carrying Capacities of Copper Wires.—The following table is based on a current density of 1,000 ampères per square inch; the loss will then be 2 volts for 80 yd.:—

No. S.W.G.	*Diameter in Inches.*	*Area in Square Inches.*	*Current in Ampères.*
22	·028	·0006	·6
20	·036	·0010	1
19	·040	·0012	1·2
18	·048	·0018	1·8
17	·056	·0024	2·4
16	·064	·0032	3·2
15	·072	·0040	4
14	·080	·0050	5
13	·092	·0066	6·6
12	·104	·0085	8·5
11	·116	·0105	10·5
10	·128	·0128	12·8

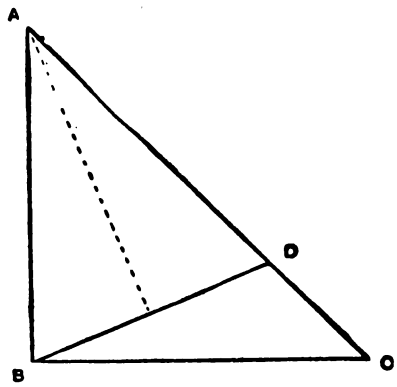
It is unnecessary to add stranded cables to the above table, as their working currents may be calculated direct from it. For instance, 7/16 S.W.G., consisting of seven strands each No. 16 S.W.G. in size, will carry $7 \times 3{\cdot}2 = 22{\cdot}5$ ampères (say). Similarly, 19/14 S.W.G. will carry $19 \times 5 = 95$ ampères. For currents at other current densities, multiply the current given in the table above by the density required in ampères per square inch and divide by 1,000. Thus, with a current density of 500 ampères per square inch, with a drop of 2 volts per 160 yd. (see reply 16210 on p. 353), No. 22 S.W.G. would carry $\cdot6 \times \frac{500}{1{,}000} = \cdot3$ ampère. It may be well to add that the size of any single wire should not be reduced below No. 18 S.W.G.; smaller sizes are mentioned in the above table so that the current capacities of stranded wires may be calculated. Also, sometimes the simplest way to find the drop in volts is to multiply the resistance in ohms of the given length of cable by the current in ampères.

White Spots on Polished Furniture.—These may be caused by water spotting, damp, or the use of plaster-of-Paris as a grain filler. Try rubbing the surface with a mixture of equal parts of linseed oil, turpentine, and vinegar; then clean off any greasiness that may remain by means of a swab of clean soft rag made fairly damp—not wet—with methylated spirit. Apply this lightly at first, then, as it becomes drier, press a little harder and finish in the direction of the grain.

Making Tongues on Spokes of Cart Wheels.—Take off the tips of the spokes to about the size of tongue required with a tool somewhat like a large countersink inverted, with cutters inside, then with the hollow bit cut down to depth; this cuts the shoulder at the same time as it makes the round tongue. To do it by another method, mark in the front of the tongue parallel with the set-stick fixed to the front of the stock, by which the spokes were guided when driven in; then mark off the diameter, saw in to these marks back and front, split off, and with the draw-knife pull it out short at the sides and trim up round, using a fitter to guide the size. A tongue made this way is much stronger than when the shoulder is cut in square all round, as the grain at the side of the spoke is not cut so short.

Preparation of Pitch Pine for Varnishing.—Pitch-pine furniture is generally finished by the application of several coats of good quality spirit varnish. Interior fittings likely to be subject to hard wear are best finished with a good oil varnish, such as church oak. Pitch-pine goods are sometimes first coated with size, with a view to prevent suction. Many have a preference for first coating with spirit varnish, as it gives the articles a good colour, and any good quality oil varnish will dry thereon. If a first coat of varnish is not sufficiently hard to allow flatting with pumice in three days' time, the drying qualities are poor, or it may have been applied too thickly or by a dirty brush. Drying may sometimes be hastened by sponging down with cold clean water. Another plan is to coat with naphtha or spirit varnish; the result can also be gained by coating again with a thin oil varnish, the drying qualities of which have been hastened by the addition of japanner's gold size.

Cutting out Umbrella Covers.—For umbrella covers, first make the pattern by which to cut out the sections or gores. This may be of strong paper, but for permanent use sheet zinc is best. First cut a square of paper, each edge of which is exactly the same length as the frame on which the cover is to be placed—that is, a 25-in. frame would take a square of paper with edges 25 in. long. Cut this across from one corner to the opposite corner to produce a piece shaped like A B C in the



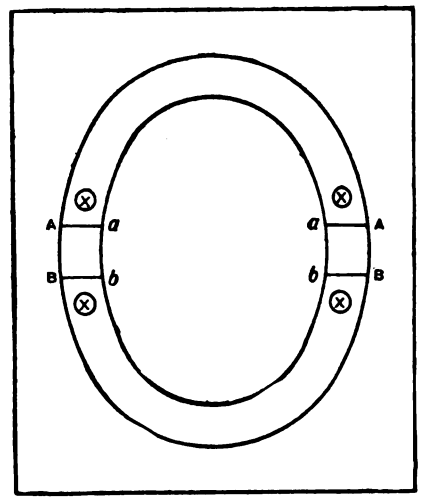
Pattern for Umbrella Covers.

illustration. Measure from A towards C the same distance as from A to B (in this case 25 in.), and then cut along the line D B. The part A D B now forms the complete pattern. By measuring down the centre as shown by dotted line, the width of cloth necessary to cut the cover will be discovered. For 25-in. covers cloth 22 in. wide is required. Always place the edges B D towards the selvedge edges of the cloth being cut, and allow a margin for hemming and sewing together. Sew the top of the cover with strong thread after machining.

Flow of Water over a Weir.—The following is a rule for finding the exact discharge of water in cubic feet, or gallons per second, passing over level weirs. The depth of the water on the weir × width × velocity, all in feet, will give cubic feet, and this × 6¼ will give the discharge in gallons. To find the exact quantity of water that is flowing over a weir would be a very difficult matter unless proper provisions were made for gauging the depth of the water and its velocity. For rough approximation the depth would be the difference in level between the weir and surface of still water above it, but with an allowance for curvature of the surface on the weir, which varies considerably. For the velocity it would be necessary to time the movement of a floating object, and from this make a deduction, as the surface travels at a higher speed than the bottom.

Hints on the Manufacture of a Speculum.—In the manufacture of specula, plate glass is used, provided the size of the mirror is not such that the disc has to be specially cast. The thickness is in proportion to the diameter, the general ratio being as 8 to 1—that is to say, the diameter of the speculum should be eight times its thickness. A safer ratio is 6 to 1—at any rate for large mirrors, where the question of flexure is an important consideration. Supposing the diameter of the speculum to be 10 in., its thickness would be 1¼ in.—certainly not less than 1¼ in. Before deciding the curve, the focal length of the speculum must be determined, as this, of course, in turn determines the length of the telescope. If the latter must be short, the former must be short also, and the curve of the mirror must be correspondingly deep. This will render the figuring much more difficult to work than when the speculum has a long focus. The general practice is to make the focal length twelve times the diameter of the mirror, which, in the case of a 10-in., will be 10 ft. The curve of a speculum, though first ground spherical, is not left so, but is deepened to a parabolic form, as it is found that a spherical surface is unfitted for astronomical work. Parallel rays, when received on such a surface, result in an indistinct image at the eyepiece. Practical experience shows that the curve should be such that parallel rays received on it will come to a focus midway between the mirror and its centre of curvature. Therefore, in a 10-in. speculum the curve must be part of the circumference of a circle having a radius of 20 ft.

Making Zinc Stencil Plates.—Zinc stencil plates for marking boxes and sacks may be cut by hand with the aid of a mallet, a sharp chisel, a pair of bent-nosed snips, and a plate of thick sheet zinc. Taking the letter O, shown by the accompanying diagram, commence by drawing the



Making Zinc Stencil Plates.

letter; then, assuming that the inside part of the figure is to be held by the straps A B, A B, take the chisel, and, laying the stencil plate upon the sheet zinc plate, cut it through along the lines A *a*, B *b*, then, with a circular hollow punch, punch out the holes X, X, X, X. Insert the nose of the open snips through the holes alternately, and cut through the zinc to the corners A *a*, B *b* on both sides of the figure; then, from the open spaces formed, cut round with the snips upon the lines drawn, smooth the burr down upon an anvil with a few blows from a smooth mallet, and trim the cut edges with a smooth file to finish the plate. Letters formed by straight lines, as E or F, can be cut by the use of the chisel only.

Etching on Steel.—To write names, etc., on steel cover the surface to be marked with a thin layer of asphaltum varnish, making a little bank at the edges. On the varnish write the names, etc., with a steel scriber, and, in the small basin formed by the asphalt banks, pour a weak solution of nitric acid. When this has eaten in to the required depth, wash with hot water, removing the varnish with hot turpentine. Instead of asphalt varnish, soft beeswax is often used, and an etching fluid may be made from iodine 1 oz., iron filings ½ dram, and water about 4 oz. A solution of iodine, potassium iodide, and water is sometimes used; also a solution of 1 part of nitric acid (by measure), 1 of hydrochloric acid, and 10 of water.

Dyeing Curtains and Tablecloths Turkey Red.—The red dye fastest to light, washing, etc., is alizarin or Turkey red. For wool, mordant with a bath of sulphate of alumina and cream of tartar, and dye in a bath of alizarin paste and acetate of lime. For 100 lb. of wool use 10 lb. of sulphate of alumina, 5 lb. of cream of tartar, 10 lb. of alizarin paste, and 5 lb. of acetate of lime. The dyeing of cotton is a more complicated process.

Paint Blistering on Woodwork.—Blisters in almost all cases are due to the escape of moisture that is present in all wood, new or old. New wood is, of course, more liable than old to give off moisture, and the paint to become more blistered; but old wood will show the same effect if exposed to the heat of the sun. It may be that exposure to the sun is the cause of the paint blistering on this particular door, and in that case the only remedy is to hang over it a kind of sun-blind, made of plain or striped canvas, during the summer months. This is a very general practice in the London suburbs, and is found to be the best protective. If the door is to be repainted, then see that the work is done in dry weather and with dry brushes. The old paint will have to be burnt off, and more turps and less oil may be used with advantage in mixing the new paint, as a more porous film of paint will in this way be obtained.

Fixing Mooring Bollards.—For mooring steamers of about 900 tons, the concrete block for the mooring posts or bollards should be not less than 7 ft. 6 in. square and 8 ft. deep, with a block of Bramley Fall stone 5 ft. square and 1 ft. 6 in. thick on top. The part of the bollard above the ground line is usually a separate casting, securely bolted to the foundation column, which is bedded in the concrete, with a flange at the bottom bolted to two 12-in. by 12-in. baulks of creosoted memel. The shape of the upper casting varies from a post with rounded head and hollowed side, or a capstan-head shape, to a tall or short hook shape. The thickness of metal is about 1¼ in., tapering to 1 in. at the bottom of the concrete. The diameter where the rope goes is about 18 in., and the bottom end 15 in. The engineer of the dock usually gives the design both for the bollard and the foundation, as every part must be calculated to do its duty efficiently.

Adding an Electric Alarm to a Clock.—To fix an electric bell to a Vienna regulator clock, arrange the electric circuit so that the battery is in a convenient position, and the bell in the bedroom; include the clock in the circuit. One wire should be carried through the case and soldered or screwed to any part of the brass movement, preferably the front plate. The other wire should be carried to the edge of the dial, and should lie flat upon it pointing towards the centre, the end being brightened and hammered flat so as not to stand up much from the dial surface. A piece of paper gummed on the dial beneath it will serve to insulate it. The connection is made by the hour hand having a thin flexible piece of brass soldered to the end of it to make contact with the copper wire at the dial edge as it passes over it. This extension may be painted white, so as not to confuse the eye. This arrangement will make contact every twelve hours, but may be switched off during the day.

Reading a Gas Station Meter.—The gas made on a gasworks is always measured by the station meter, and in modern establishments corrections are made for temperature and pressure, in order that the gas may be measured under standard conditions, since, as the height of the barometer, and more especially the temperature of the atmosphere, varies at different seasons of the year, the measurement of the gas is affected in accordance with the atmospheric conditions prevailing; hence, in practice, the volume of gas passing through the station meter is always reduced to the standard conditions of 60° F. and a barometrical pressure of 30 in. of mercury. The calculations are based upon the following physical laws. By the law of Boyle or Mariotte, the volume of a given mass of any gas, assuming that the temperature is constant, varies inversely as the pressure to which it is subjected; or, in simple language, doubling the pressure reduces the volume to one-half, while, conversely, reducing the pressure one-half doubles the volume, and so on in a similar ratio. Now, supposing a station meter registered 10,000 cub. ft. of gas under a barometrical pressure of 30·5 in., and we wished to reduce the volume to the standard pressure of 30 in., since the pressure under which the gas is measured is greater than the standard pressure (30 in.), it is plain that under the last-mentioned pressure the volume would be greater; consequently, we say,

As 30 : 30·5 :: 10000 : 10166 cub. ft.

Or, supposing that we measure the same volume of gas under a pressure of 29·5 in., and we wished to know the volume at the standard pressure; in this case, the gas is measured under a lesser pressure than the standard, consequently, when reduced to the latter pressure, the volume would be reduced; so in this case we say,

As 30 : 29·5 :: 10000 : 9833 cub. ft.

It will be noticed that in each case the standard pressure (30 in.) occupies the first term in the statement. With regard to temperature, as is well known, gases expand with heat and contract with cold, and the amount of this is expressed as follows. The volume of a gas expands or contracts by $\frac{1}{491}$ part of its volume at 32° F. for every increase or decrease of 1° F. Now supposing we measure 10,000 cub. ft. of gas at a temperature of 80° F., and we wish to correct it to the standard temperature of 60° F. (the pressure remaining constant), 492 volumes at 32° F. become 492 + (60 − 32) = 520 volumes at 60° F., and 492 + (80 − 32) = 540 volumes at 80° F. The volume, therefore, of any gas at 80° F. would bear the same ratio to the volume which it would occupy at 60° F., as 540 does to 520; consequently,

As 540 : 520 :: 10000 : 9629 cub. ft.

If the gas, instead of being measured at 80° F., had been measured at 40° F., then, as before, 492 volumes at 32° F. would become 520 volumes at 60° F., and 429 volumes at 32° F. would become 492 + (40 − 32) = 500 volumes at 40° F. Then the ratio of the volume at 60° F. would be obtained as follows—

As 500 : 520 :: 10000 : 10400 cub. ft.

It will be noticed that 520 always occupies the second term in the proportion. In practice, the volume of a gas is always corrected for temperature and pressure at one operation by combining the two corrections and making a compound proportion sum of it, and as two of the terms always occupy the same position, by cancelling we obtain this expression—

$$\frac{17{\cdot}333 \times p \times V}{460 + t} = \text{corrected volume},$$

p being the pressure under which the gas is measured, V the volume, and t the temperature under which the gas is measured. In gasworks, however, these corrections are usually performed by means of a series of tables drawn up by the Metropolitan Gas Referees, based on the principles already explained, but also taking into account the tension of aqueous vapour, the formula from which their numbers are obtained being—

$$\frac{17{\cdot}64\,(b - a) \times V}{460 + t}$$

a representing the tension of aqueous vapour to be deducted from the height of the barometer according to the temperature under which the gas is measured, while 17·64 only differs from the 17·333 previously given by deducting from 30 the tension of aqueous vapour at 60° F. By the aid of these numbers all that is required is to observe the temperature of the thermometer at the inlet of station meter, and the height of the barometer, then find the number corresponding to them, and multiply the volume of gas by the number, when the corrected volume at 60° F. and 30 in. will be obtained.

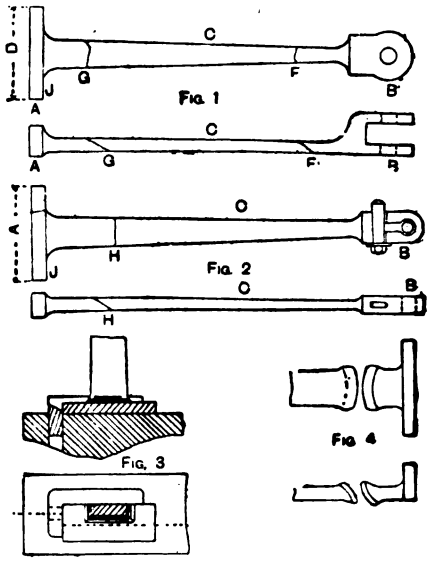
Smoky Kitchen Chimney.—It is unusual for close-fire kitcheners to give trouble by smoking, and unless the cause is down-blow (which only occurs when the wind blows from certain quarters), then it must be concluded that the range is not properly fixed. Supposing the chimney is clear, it should be ascertained whether the brickwork of the chimney above the range is well clear of the flue outlets. There should be at least 12 in. clear space between the flue outlets at the top of the range and any brickwork that may come above them. If all is right in this direction, then ascertain whether there are any means by which air can enter the chimney from the room without passing through the fire, which is a common cause of kitcheners working badly, though it may not always make them smoke. The range should be set sound and air-tight, and there must not be any other flues running into the range chimney, except, perhaps, the copper flue, which must have a damper, to be closed when the copper fire is not alight. There must not be openings of any kind by which air can pass into the kitchen chimney except it go through the fire. It must be ascertained that the soot doors are complete and in their places, and that there are no apertures in the chimney. The position of the fire in its relation to the room door need not be considered with these close-fire ranges.

Removing Fat from Sheepskins.—Practical curriers immerse the skins in fermented bran and water. Washing the skin in a solution of potash will also remove surplus oil; so also will soap and soda and water. Having taken away the oil, stretch the skin out to dry, and, whilst it is doing so, scrape it and rub it in every direction to prevent it drying hard.

Brass Polishing Composition.—Crocus is very good for polishing any metal under the hardness of iron, and it may be used for finishing iron and steel, after the rough polishing is done. It may be made into hard cakes by mixing with lard, suet, or tallow, first melting the tallow and then stirring in as much crocus as the tallow will hold, and pouring into an open oblong box, the sides of which may be taken apart to release the cake. For a paste to be put up in tin boxes, the crocus may be mixed with soft soap, with a percentage of a common oil to be ascertained by experiment, the oil preventing the paste from becoming hard. The former composition would be useful for lathe polishers, and the latter for domestic and general use.

Photographing a Procession Instantaneously.—To take a series of photographs of a procession, the camera should be directed up the road so that the procession is shown approaching. Do not attempt to take the procession broadside on, as the exposure will need to be much more rapid owing to the movement appearing far more noticeable. The most rapid plates, Cadett "Lightning" or Ilford Special Rapid, should be used. The light varies so that it is practically impossible to say what exposure to give. Much will also depend upon the surroundings, direction of light, and the character of the procession—that is to say, whether the clothing of the processionists is dark or light. Experienced photographers usually endeavour to make a couple of trial exposures on the crowd a little before the event; by developing the plates at once they are enabled to get an idea of the exposure required. For the trial exposure use full aperture, and let the shutter work as quickly as possible. Develop one plate first and make a print: from the result it may be possible to suggest how the subsequent prints may be improved. Two or more cameras clamped to the window frame should be used. They should be focussed before the procession arrives.

Forging Rods for Engine.—To forge the two rods shown in the accompanying dimensioned sketches, if steel were used and a steam hammer available in an

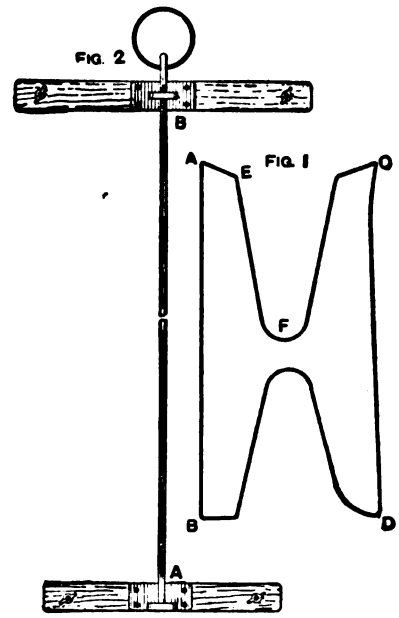


Forging Rods for Engine.

engineer's shop, the webs might be drawn down from the larger ends. Iron of common quality should be welded so that the fibre in the flat ends may run lengthways of the ends; or the ends would be opened out to form the flat. Again, where there is uncertainty about exact centres, as in valve setting, welding up to length is often done after the fitting of the ends. For convenience, the web may be drawn down from both ends, and welded about the middle or towards one end. The forked ends are, when in the dimensions given by the correspondent, forged solid, and then slotted out. They might, however, be forged roughly to dimensions over a former block, leaving little to be tooled out. As a general rule, the greater the difference in the dimensions of the two enlarged ends the greater the reason for drawing down from two pieces, and then welding. Upsetting to any considerable amount is objectionable both in iron and steel. If the whole of the work must be done on the anvil without a steam hammer, make the two ends as separate forgings, and weld the web to them with two welds (G, F) in the case of Fig. 1, and with one only (H) in Fig. 2, more drawing down being necessary in the case of Fig. 1. For the feet A, take a piece of flat bar and draw down the portion as far as H, fullering it on faces and edges alternately, and leaving the end upset for welding to the web. The inner face J is brought fairly flat by up-ending the broad face on the anvil and going over J with a hammer first, and flatter afterwards. The blows tend to make the forging strike backward, so a block (Fig. 3) must be set in the shank hole of the anvil as a support. For the other ends B, B a bar will be taken a little larger than the finished section, and the webs will be drawn down to F in Fig. 1, and to H in Fig. 2. There is very little drawing down in the latter case. All the weld ends must be upset, and the joints scarfed and rounded (Fig. 4). The lengths of the welds need not exceed 1½ in. Centre pops and a fixed trammel must be used to check the lengths during welding.

Damp Preventive for Brickwork and Stucco.—For painting brickwork and stucco exteriors to repel the damp, amongst many other materials the following have been recommended: (1) Boiled oil applied hot; (2) soft soap and alum, the latter applied twenty-four hours after the former; (3) Czerelmy fluid, presumably a silicate; (4) boiling tar; (5) silicate or other good oil paint. For stucco work a coat of Portland cement as thin as cream, applied with a whitewash brush; boiled oil applied hot and afterwards painted regularly; ordinary oil paint applied regularly.

Making Trousers Stretchers.—The simplest form of trousers stretcher is that illustrated by Fig. 1; it is known as the "Invisible" trousers stretcher, as it is used by putting it inside the trousers leg. It is made of stout iron wire. The dimensions are as follows: A to B (Fig. 1), 30 in.; C to D, 29½ in.; A to C, 14½ in.; B to D, 15 in.; A to E, 4 in.; E to F, 14 in.



Trousers Stretchers.

Of course, one is required for each leg. The device is patented. Another kind is that shown by Fig. 2, which is drawn on a larger scale than Fig. 1. Four pieces of wood, ¼ in. thick and 1½ in. wide, are required; two 16 in. long, and two 13 in. Holes are bored near the ends, and the pairs are fixed together by small bolts and thumbscrews. The longer pair belong to the top of the stretcher. A metal socket is screwed on at A (Fig. 2) to receive the end of the bar, and there is a receptacle at B (Fig. 2) having a thread in it, through which the screw of the rod is turned. The rod, which is of metal, is about 33 in. in length, and has a screw for about 6 in. of its length from the top. Trousers should be folded by bringing the two front brace buttons together with the left hand, and then taking each bottom at 3½ in. from the side seam, and bringing them together also; the crease thus formed is the centre line of the leg. The trousers are thus laid in the stretcher, the bottom being fixed first, and the screws tightened; then the top as far up the leg as it will go, and the stretching is accomplished by turning the ring at the top. The articles should then be left for some time.

Filling Cracks in Blackboard.—As a filling for cracks and holes in a wooden blackboard, if the crack is ¼ in. or more in width, a slip of wood should be fitted and glued in the opening and afterwards planed down level to the surface of the board. But if the crack is less than ¼ in. wide, it can be filled in with a mixture of plaster-of-Paris, glue, and a little lampblack. This should be allowed to dry, and then scraped and glasspapered flush with the surface of the board.

Renovating Lacquer of Microscope.—To clean a microscope that has become rusty through lying in a damp place, well rub the affected parts with paraffin. If the spots are merely superficial the paraffin will fetch them off; but if the damp has penetrated deeper, the only remedy is to remove the entire coating of lacquer, re-polish the metal, and re-lacquer. To do this, remove the lenses, take the microscope to pieces, and boil the lacquered parts with a handful of strong soda in water. This will remove every trace of the old lacquer. When dry, with some No. 1 blue-black emery paper grain the pieces as before. The old graining will give the direction. When all the pieces, screw-heads, etc., have been separately grained, they must be separately heated and lacquered. The draw tubes, if stained, need only be cleaned up with paraffin; but if it is thought desirable to paper them also, they must not be lacquered, but should be rubbed over with vaseline instead.

Silvering Brass and Copper.—Any article of brass or copper can be silvered by the French-silvering process as follows: Dissolve a stick of nitrate of silver in ½ pt. of water; add common salt, which will deposit the silver in a white mass at the bottom. Pour off the water and add fresh, stir up, allow to settle, and pour off again. The residue is silver chloride. To use it, clean the metal with fine emery-cloth, wash it in cold water, and rub its surface with salt brine. Then rub it over with a rag on which is a paste composed of equal quantities each of silver chloride, cream of tartar, and water. Continue rubbing until it is evenly silvered all over, then wash in plenty of water and dry with a soft clean cloth. Any silver chloride not used can be dried in the dark and kept in a bottle away from the light for future use. It is best to silver by gaslight or weak daylight.

Duresco and Petrifying Liquid.—The nature of Duresco and petrifying liquid, and the proper way to use them on damp walls has been explained as follows:—Duresco is a water paint consisting of pigments ground up in a medium containing water; petrifying liquid, as made by the Silicate Paint Co., is a solution containing certain chemicals which combine with stone, etc., to form a hard, impervious coating; the same result is obtained when Duresco is thinned with the petrifying liquid and applied to walls. For application to damp walls, the Duresco body colour must be thinned with petrifying liquid or Duresco liquid in the proportion of 1 to 4. Duresco is very often effectual on interior damp walls, but the benefit cannot be considered permanent, as continual dampness entering the walls from the outside rots the plaster. Duresco is no good in cases of dampness arising from foundations. The cause of the dampness must first be removed. Three coats of Duresco should then be applied thinned down with the petrifying liquid. Petrifying liquid alone will prevent moisture penetrating, but is not so effe tual as Duresco, and is only used where a painted effect is not required. Three coats of this should also be given. Duresco and petrifying liquid are both patents. For porous bricks, Duresco should be applied outside the house.

Camera View Finder.—A view finder is an apparatus in which can be seen a miniature representation of the picture that is thrown on the ground-glass screen of the camera. It is fixed outside the camera in such a position, that when the image is focussed sharply on the ground-glass screen, the finder shows the same image just as sharply focussed. When a finder is used, therefore, it is unnecessary to focus the picture on the screen, the finder being used instead, and the convenience of such a procedure is obvious. A finder is absolutely necessary with a hand camera, and a very valuable adjunct to a stand camera. Care should be taken to see that the finder includes no more of the view than is shown on the screen of the camera. If the finder includes too much, reduce it to the proper dimensions by pasting strips of dark-coloured paper on the screen of the finder.

Tuning a Piano.—A wedge, a tuning hammer, a piece of ivory, and a tuning-fork are necessary. About 7s. 6d. should be paid for the hammer, for unless the temper is good the continual strain will soon cause it to wobble on the pins. Care should also be taken to ensure its adaptability for the instrument in hand; thus, some instruments are fitted with square heads, others with oblong ones to the tuning-pegs. The wedge is used to stop the vibration of one string of a note whilst the other is tuned. Wedges are usually made of lancewood, rosewood, or whalebone about 8 in. long, ¾ in. wide, and ⅛ in. thick, each end being covered with varying thicknesses of doeskin; they cost about 1s. each. The piece of ivory is generally a portion of an old key covering, and is used for the purpose of plucking the wires in the first stage. A C tuning-fork costs about 1s. 3d. Tuning-forks should never be struck on any hard substance; such practices have a tendency to flatten them. Tuning may be said to embrace four stages—chipping up, rough tuning, tuning, and fine tuning; space will not permit of each stage being fully dealt with. Briefly, after the instrument leaves the stringer's hands it is chipped up—that is, the action is left out, the wires being merely plucked with the piece of ivory referred to above. When all the wires have been somewhat pulled into tune the action is put in and the tuning is followed through various stages by means of the hammer and wedge. As the tuning-pegs are merely held in position by being turned into a wood plank, care should be taken to prevent any unnecessary wriggling about; especially avoid straining the pegs upwards or downwards, instead of turning them. It requires a firm grip and strong wrist

Yellow Stain for Oak.—A suitable stain is gamboge, steeped in methylated spirit; this yields a powerful yellow tone. If this, or turmeric, does not suffice, try lemon chrome mixed in 1 part French polish and 3 parts spirits; or a yellow aniline dye, mixed with 3 parts water and 1 part vinegar.

Stain for Edges of Brown Boots.—To make this, get a pennyworth of burnt sienna in water, and mix it with water; shake well before applying to the edges of the boots so as to get an even stain. Put it into two small bottles, say two-thirds in one bottle and the remainder in the other, with equal parts of water; this will give two shades of brown.

Hoisting the Materials for a Tall Chimney.—The usual method of hoisting the materials for a tall chimney in course of construction is to have outside the foot of the chimney a steam crab or winch, provided with a wire rope of sufficient length to reach to the top of the chimney and down again—about 400 ft. in length for a chimney 160 ft. high. In the base of the flue, a snatch-block is attached to a rail, or a rolled joist is built in. As the chimney is carried up, a couple of rolled steel joists are laid across the flue, on which is laid a plank floor, with a square opening in the centre for hoisting through, and three shear-legs with pulley-block are erected. The brickwork is carried up about 9 ft., and two other steel joists are laid across, the shear-legs being dismantled and refixed at the higher level, as is also the plank floor. When the next stage is reached, the first two joists are taken out and refixed at the higher level, and the shear-legs again moved, the operation being repeated every 9 ft. or so until the top of the chimney is reached.

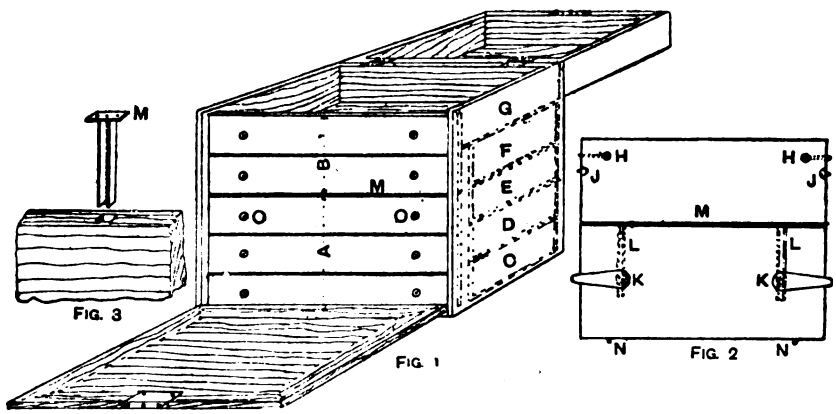
Producing Squeak for Punch and Judy Performances.—A penny squeaker is used to produce the peculiar squeak by professional Punch and Judy men for their performances, but, as a rule, these instruments are too large and roughly made. Pronounce the word "cow" or "come," and notice where the hinder part of the tongue touches the roof of the mouth. This is where the instrument must be placed, and held in position by the tongue pressing it against the palate, while the front portion of the tongue, the lips, and cheeks are left free to modulate into words the sounds produced by blowing through the squeaker. A serviceable one may be made of two pieces of tin, 1 in. by ½ in., slightly curved, with a silk ribbon, ¼ in. broad, stretched tightly between and wrapped round once or twice. The whole is tied round with thread. The corners should be cut off the pieces of tin, or they will injure the roof of the mouth. The silk produces a clean, smooth voice, although for open-air performances, where a very loud voice is requisite, ordinary tape in a larger squeaker is preferable.

Heating Cucumber House.—To heat a glass house, size about 10 ft. square, for growing early cucumbers, a boiler to burn coke, with 3-in. or 4-in. cast-iron hot-water pipes, is recommended. A gas boiler would not prove so economical and requires careful fixing to shelter it from the wind and weather, which may cause it to light back or be extinguished. The Loughborough type of boiler, which is supplied with pipes, etc., complete, is generally found to be suitable. The pipes have expansion joints, and the whole is expressly made for amateurs' requirements, no skill being needed in putting up the apparatus. The boiler is fixed in the thickness of the wall and requires no pit or special provision of this kind. If the height of the house averages 7 ft., then 35 ft. of 4-in., or 40 ft. of 3-in., pipe will be required. The pipe can be carried along two or three sides, below the glass, where the house is expected to be coldest.

Removing Stain and Varnish from Furniture.—To each bucketful of freshly slaked hot lime add about 2 lb. of common washing soda. Apply liberally by means of old brushes. Carved portions may be cleansed by making the mixture into a paste by adding more lime or sawdust. Spread this over by means of a palette knife. Several applications may be neces ary. Swill off with clean water, and finally wipe over with common vinegar to neutralise any trace of acid left in the wood.

Solutions for Etching on Brass.—A reliable solution may be made by dissolving nitric acid in about five times the quantity of water. Another solution is made by mixing a solution of nitric acid and water (1 to 10 parts respectively) with about an equal quantity of potassium chloride dissolved in 16 of water. A mixture of nitric acid 20 parts with 1 of muriatic acid, may be used, or a solution containing equal quantities of nitric acid and water and a few small pieces of copper may be tried.

Jewel Case with Secret Drawers.—The following instructions for making a jewel case with secret drawers refer to one about 12 in. by 10 in. by 8 in. Fig. 1 is a view of a jewel case when open; the carcase is put together with secret dovetail and mitred joints. The front or flap is mitre clamped and veneered on the face; the four drawers which the case contains are all hidden. The front A B (Fig. 1) is made in two parts, and represents the fronts of five drawers, A being made the height of drawers C, D, and E, whilst B is the height of drawer F and tray G. The bottom of G is a fixture, as are also the divisions between drawers F E, E D, D C; the front A is made as shown, with two scratch beads at equal distances. The bead M, which divides the front, is loose; to it are fixed two steel forks, which fit into the square mortises (Fig. 3); the two drawer knobs K K (Fig. 2) have a small square spindle attached, over which the steel fork passes, and fixed on the end of the spindle is an iron tongue and nut forming a turn-buckle. When the knob is turned so that the front is fixed, the fork K is dropped and fixes the front A, and, until lifted, the latter cannot be moved. N N are dowels fitted into the bottom of the case; the front B is made to work on pivots J J and is fixed by springs H H (Fig. 2). These springs are hidden by the silk lining of the tray, and, until released, the front A will not move; when the springs are released the front will fall on the bottom of tray G, giving access to the bead M. In a shallow case it will be necessary to form the movable knob at O O, or the forks L L will not draw out sufficiently to release the front A.



Jewel Case with Secret Drawers.

Glazing Tobacco Pipes.—For a glaze, dissolve 1 part of acetate of lead (sugar of lead) in 5 parts of water, and dip the pipes into the solution or apply with a brush; then, after drying, fire at a low red heat. Another glaze is made by melting together in a crucible 1 part of carbonate of potash and five parts of borax; pour the melted mass into an iron plate, powder it very fine, and mix with turpentine. Apply the wash with a brush and fire as above.

Standard Acid and Alkali Solutions.—Standard acid and alkali are solutions of an acid or alkali the exact strengths of which are known. The usual standard solutions are the "normal" and the "decinormal." The normal solution of hydrochloric acid contains 36·5 gram. hydrochloric acid in 1 litre; the decinormal contains one-tenth of this amount. The strength of a solution of an acid or an alkali is determined by measuring, say, 10 c.c., and titrating with either alkali or acid, as the case may be, and using some indicator, such as litmus, which changes colour when the point of neutrality is reached; the standard solution is dropped in from a burette, and when the titration is finished, the amount of standard solution used is read off, and from this it is easy to calculate the amount of acid or alkali present in solution. A "factor" is sometimes used for calculation when the strength of the standard solution is not exactly correct; for instance, suppose we have an absolutely correct standard acid, and we then make a standard soda solution which is rather too strong, instead of diluting it to the correct strength, we may use it as it is, and multiply the results by a "factor." Suppose 10 c.c. of the standard acid requires 9 c.c. of the soda solution, then the latter is $\frac{10}{9} = 1{\cdot}11$ times too strong; the figures 1·11 constitute the "factor."

Laying Concrete Floor.—Although some experts recommend that, for stability, a concrete floor should be laid in three layers, the upper and lower of strong material, having the bulk of rougher material between them, this plan is not followed to any great extent, and the utility of the intermediate course is doubtful. In order to make a strong homogeneous concrete, the voids in the aggregate must be filled with some finer material; it would be an improvement if the material intended to form the first two layers were incorporated and laid as one. The finishing coat may, if desired, follow closely upon the laying of the rougher material, but it will be better if the bulk is allowed to set first; and three days afterwards will be a very suitable time to finish off the floor, provided there is no need of hurrying the work forward. After the fine stuff has been ruled off, as soon as the surface begins to get firm, is the proper time to commence finishing-off; if this is commenced too soon, an unequal surface will result, whilst if the stuff is left to get too firm, the surface will be rough and patchy. A hand float should be used at first, and with this the work should be beaten lightly, or patted until the "fat" appears; then trowel off with light strokes until the desired face is obtained.

Preparation Used by Fire-eaters.—The preparation used by so-called fire-eaters to make the skin resist the action of fire is strong solution of calcium chloride which would remain moist on the skin and protect it to some extent. The fire is obtained by burning a small quantity of the lightest naphtha. This rapidly dies out, and produces but little warmth. This naphtha is often poured on tow and ignited, but the flame at once dies out when placed inside the mouth.

Boiled Oil as a Damp Preventer for Brick Walls.—Boiled oil has been highly recommended as a cure for dampness caused by absorptive bricks. Its efficacy is due to the fact that it fills the pores of the bricks. It should be applied boiling hot, and rather lavishly, with a large paint brush or even a Turk's head brush. A dry summer day should be chosen, and if possible, a time when the wall is warmed by the sun. The coating should be renewed every two years. It may rather discolour the brickwork if the facing is new stock or terra-cotta bricks, but will hardly be perceptible with old or common work. A small area should be tried at first, so as to afford some idea as to the ultimate appearance of the whole.

Re-enamelling Bath.—To re-enamel a hot and cold water bath, specially prepared enamel paints are used. Thoroughly clean the surfaces of the bath with petroleum and well scour rusty places with emery cloth; when clean and dry, rub in a paste of lime and petroleum; wipe this off before painting. Apply two thin coats of paint; allow the first coat to dry hard before applying the second. Pale green or eau-de-nil are good tints.

Printing Photographs on Fabrics. — There are several methods of printing photographs on fabrics. The simplest is the platinotype, as the material—silk, satin, linen, calico, etc.—is supplied sensitised and ready for use by the Platinotype Co. It is treated in the same way as paper, being printed to the required depth and developed by immersion in a saturated solution of oxalate of potash or in the D salts supplied by the company. It is fixed by immersion in one or two baths of hydrochloric acid—strength 1 in 60—and merely requires half an hour's washing in running water. A very permanent image which will stand washing may thus be produced. The prepared material is somewhat costly, therefore the following plan may be preferred. Procure some pure silk—not treated with acetate of lead—and immerse for two or three minutes in a salting solution prepared as follows: Boil 2 dr. of arrowroot in a little water and dissolve and add 75 gr. of chloride of ammonium and make up to 32 oz. of water and filter. When the silk is dry, a sensitising solution of silver nitrate 40 gr., citric acid 1½ gr., water 1 oz. is brushed over it, the fabric being pinned flat on a board. Print as usual, but very deeply, and tone with water 5 oz., sodium acetate 7 gr., chloride of gold 3½ gr. Allow this bath to mature for twenty-four hours before using it. Very pleasing results are obtained by merely fixing without toning. Well wash before toning, and place in a bath of common salt and water before fixing in hyposulphite of soda 2 oz., water 1 pt. The pictures may be coloured with crayons and a very beautiful effect produced. The crayons may be fixed by spraying with a solution of rubber in benzole. The picture, if not coloured, may be washed in cold running water. By the "Primuline" process prints on a yellow ground may easily be obtained in red, scarlet, crimson, maroon, orange, brown, etc., by sensitising with primuline and treating after exposure with a developer. In printing fabrics, great care must be taken when examining the print lest the material should be stretched, when a blurred and distorted image will result. Gauge the exposure by experience, or use an actinometer, when the material may be stretched on a light frame. Absolute contact must, however, be assured. The grain of the material must not be too marked or a coarse effect will result.

Sinking a Tube Well through Chalk. — A deep stratum of chalk would be penetrated by boring, for which purpose a tube of large diameter is necessary. A frame, which holds the first length of tube in position vertically, is set over the selected spot. The lower edge is not sharp, but rough jagged, and the work is performed by revolving the tube by means of a portable engine and horizontal pulley wheel on the frame through which the tube passes and to which it is wedged; a bag of sand placed on the top of the tube adds weight when required. When one length is nearly down, the boring is stopped and dredging commenced. A heavy piece of tube, about 2½ ft. or 3 ft. long and small enough to go inside the well tube, has its lower end edges slightly sharpened and is fitted with a valve; a small bar is riveted across the upper end, and filed off flush outside. To this bar is attached a piece of strong cord—that known as "cod line" is suitable. By repeatedly dropping this down the well tube and pulling it up and emptying, etc., the borings are withdrawn; when advantageous, water is poured in. Lengths of tube are added as the boring proceeds.

Welding Cast Steel. — In welding cast steel, the flux may consist of borax ½ lb., washing potash ½ lb., and a small quantity of powdered white glass. These should be melted together and pounded. Cast steel should be kept from the air when heating over breeze—not coal—and should not be raised to too high a temperature, as it is liable to burn. The blows should be light at first. The flux mentioned above should be thrown over the surface to be worked before the material is put into the fire, more being added afterwards as required.

Cutting Steel Type and Dies.—For steel type and die-cutting a considerable plant of tools is required, consisting of, for steel-type work, a strong bench, heavy vice (about 56 lb.), an assortment of large coarse and small fine files, gravers, hammer and chisels, spring dividers, rule, square and straightedge, pump drill, grindstone, oilstone, scriber, long pliers or tongs, hand-shears, sheet-tin, and cast steel in rod; and for die-sinking work, a die-sinker's vice and hollow pad, chisels, punches and matts, curved and straight rifflers, and hand-vice. To cut type, first soften a suitable piece of cast-steel rod, file up the sides with a slight undercut, and dress the face; then scribe in the type, or, better still, mark it from a tin template. Any round holes in the face are drilled with the pump-drill; the inside work is chipped out with lozenge and round-nose chisels; the outside edges are filed in a series of vee-shaped notches to form the outline of the type. Finishing is done with gravers, holding the work (if long enough to be handled) in the left hand, or in a hand-vice against a filing slip of wood projecting from the edge of the board, and lightly cutting and skimming with lozenge and round-nose gravers. Try the work from time to time on soft lead or wet clay; when perfect, put it into a clear coke fire, heat to a cherry red, and quench in clean cold water. Then temper to a middle brown. Should any further dressing be required, procure some boxwood splints and dress off with fine emery and oil. Dies are made with a backing of iron faced with steel, the better to withstand the blows of the stamp. Most dies are either planed level top and bottom, or turned in a lathe. In this state the blank is screwed up in the die-sinker's vice, and the face dressed up with a dead smooth file. A template is now placed in the centre of the face, and the shape deeply scored with a scriber. The line may then be cut round, using hammer and lozenge chisel. If no pattern is supplied, a model must be made in modelling wax, clay, or plaster-of-Paris; and to get the depth of the die, use a sectional tinplate template. After rough chiselling, use hand-gravers to remove the chisel marks, and follow by rifflers of various curves and contours. The die can be finished dull smooth with emery and oil, using a light or heavy stick for dressing, according to the size of the work. These dies are hardened and tempered by the blacksmith who forged them, and then further dressed, using a stick, finer emery, and oil. Other dies, in addition, require to be burnished with small curved steel burnishers, lubricated with ordinary soap and water. The various plain and ornamental punches and matting tools used by the die-sinker are generally made by himself, and it is seldom that the branches of type-cutting and die-sinking are carried on by the same person.

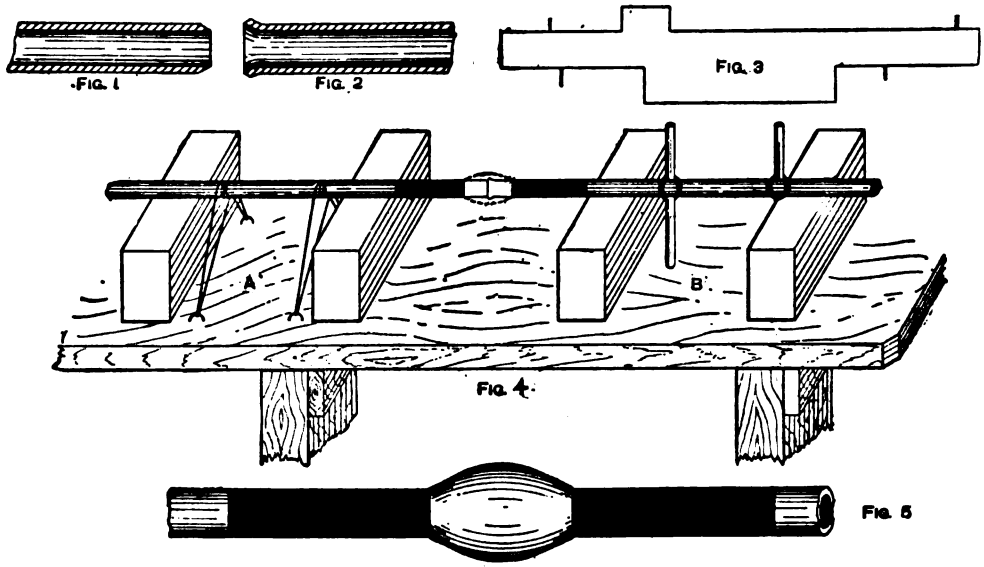
Photographing Coloured Pictures. — Coloured pictures, or any coloured object, can only be photographed successfully by the help of a screen or interceptor, which gives the true tone values of the colours. In addition, the emulsion with which the plate is coated must be specially sensitive to red and orange. Such plates (termed chromatic, isochromatic, or orthochromatic, or colour-correct) may be had of all dealers in photographic materials, those of Edwards being particularly good. These plates must be developed only in a dull ruby light. Pyro-soda is the most suitable developer. The screen may be fixed either before or behind the lens, and may either be made by staining a sheet of gelatine in a weak solution of picric acid, or purchased ready for use. Generally, the screen should be a very pale lemon yellow, but the more the two colours named above predominate, the deeper should be the tint.

Making Taps for Watchwork.—Taps for tapping screw-holes in watchwork should be made of good steel wire. First soften it by heating to a red, and allow to cool. Then file to a slow taper and thread it cautiously, using plenty of oil. When a full thread has been cut, file it triangular, and smooth the flats with a pivot file. Harden it by heating to a bright red and plunging in oil or water. Brighten the flats with a smooth emery stick, and lay the tap on a brass plate held over a lamp flame until the brightened flats show a pale straw colour.

Red Terra-cotta and Blue Bricks.—The varieties of clay used in the manufacture of terra-cotta are the blue, buff, and red clays of Cornwall, Devon, and Dorset, red London clay, and many others. Some varieties of Leeds clays are also employed. These are plastic clays, containing a moderate but variable quantity of oxide of iron—from 1½ to more than 11 per cent. The clay is treated in several ways. In some districts it is ground in the dry condition, and then mixed in pug mills; in others it is ground wet to a "slip," which is dried to the proper consistency for working on the "slip" kiln. It is usual, especially for large objects, to mix the clay with a moderate proportion of ground-baked clay, old pots, ground flint, sand, or Cornish stone, in order to prevent excessive shrinking and warping, and it is essential to allow the tempered clay to stand for some time before working. The ordinary terra-cotta bricks, facing blocks, ornamental tiles, etc., are machine-pressed, but fine objects are pressed in plaster moulds, and the larger objects are often built up and modelled by hand. Blue bricks are usually made by incorporating "mill cinder" or "iron scales" with the clay, the bricks being burnt at a very high temperature.

Lacquering Copper and Brass Candlesticks. — Take them to pieces and boil in a strong solution of soda to remove old lacquer and dirt. Dip in a weak solution of nitric acid and re-polish them. Then make them hot in an oven or on a hot plate and brush over with pale gold or gold lacquer. Candlesticks may be freshened up by brushing them over with a coating of zapon or brassoline, which may be procured through a chemist or oil and colour stores.

Wiping a Plumber's Underhand Joint.—The pipes having been dressed out straight, square the ends with a rasp. The burr should be cleaned out of the end of one pipe, and the outer arris cleaned off (see Fig. 1). Open the other pipe-end (Fig. 2) by means of a turnpin, so that the first pipe will enter as far as it is rasped off. Clean up with glasspaper and smear the pipes with a little whiting or chalk. Now mark the pipes at 6 in. from their ends by means of a gauge (Fig. 3). Paint the end of the pipe as far as the gauge mark with warm soil or smudge, and then with a shave-hook shave the pipes to a distance of 1¼ in. from the end of the first (Fig. 1), and 1½ in. from the end of the second (Fig. 2). Shave also the rasped parts of both pipes. They must now be rigidly secured in position by laying each pipe upon two bricks set on edge or upon two lengths of quartering and then holding them down by string as shown in Fig. 4. On the bench immediately beneath the pipes place a sheet of brown paper to catch the solder which falls in the process of wiping the joint. Smear the shaved parts of the pipes with tallow, which acts as a flux. Have conveniently near a pot of solder of the proper temperature, and then, with a ladle in one hand and a wiping-cloth in the other, commence to make the joint. The first stage is to pour on the metal and "tin" the joint, the second is to shape the joint, and the third



Wiping a Plumber's Underhand Joint.

and final stage to wipe it smooth. Pour the metal on to the shaved part and on about 2 in. of the soiled portions. Hold the cloth under the joint to catch the surplus solder. As the solder runs down the sides of the pipes it is caught by the cloth and pressed up against the bottom, thus helping to get up the heat and to tin the pipes. The joint should be formed quickly by wiping it with the cloth, which should be kept at the same curve all round the pipe, and pressing the edges so as to get them clean. Fig. 5 illustrates the finished joint.

Quantities for Concrete.—Approximately, the voids in gravel, if free from sand, may be estimated at from 25 to 30 per cent. of the bulk, and in broken brick or stone at from 40 to 50 per cent.; but if it is desired to obtain an accurate estimate of the voids in any sample of aggregate, fill some known measure with the material, then add water until the measure is filled; the quantity of water necessary for the purpose will be the amount of the voids. When dealing with porous materials, the water should be measured beforehand, and added to the aggregate quickly; subtracting the remainder from the original measurement of water will then indicate the extent of the voids. But in calculating the amount of sand and cement necessary to fill the voids, it must be borne in mind that Portland cement and sand both lose bulk when water is added to them, the former by about 10 per cent. and the latter by about double this percentage. It will thus be seen that the resultant cubical measurement of the materials indicated in the question will be only about that of the rough aggregate, namely, 5 yd.; and if the concrete is consolidated by ramming, there will be a further decrease in bulk by about 20 per cent., thus reducing the bulk to about 4 cub. yd.

Painters' Fillings.—The fillings used for stopping the suction of wood, plaster, etc., previous to painting, may vary according to the nature of the work. A very commonly used filler is made from starch by incorporating with it some linseed oil and varnish, adding a drier, and then thinning with petroleum naphtha. The American fillers are made from inorganic materials, such as ground silica, steatite, china clay, or barytes, and these are ground with raw linseed oil, grinding japan, and turpentine or liquid driers. These fillers set extremely hard. They are coloured when necessary with the usual pigments. A very common filler for plastered walls is made by dissolving good jelly size in hot water, and thoroughly mixing with it sufficient whiting to give it body.

Wash for Stained Stucco Work.—There is a wide range of choice in the many washable distempers now on the market; but whether any of them would cover defects so as to prevent their re-appearance depends entirely upon what causes the stains. If they are lichenous growths, an application of dilute sulphuric acid will have a beneficial effect in the matter of destroying the vegetation, but a deleterious effect upon the stucco, the surface of which will be more or less disintegrated, according to the strength of the acid. Try the effect of a good brushing with a stiff bass dandy; then, for a cheap wash, and one that will look better than a white preparation, add Portland cement to water in which white copperas has been dissolved at the rate of 1 lb. to 3 gal. Apply the mixture, with frequent stirring, in the same manner as distemper. A second coat may, if considered necessary, follow as soon as the first is dry.

Papier-mâché Mouldings.—For making papier-mâché mouldings as used for theatrical purposes, obtain some thick, coarse brown paper; tear it into small pieces 3 in. or 4 in. square, and soak them in cold water. Now make some good flour paste, and while hot, to half a gallon of paste add about half a pint of linseed oil and about half a pound of melted glue. Well mix these together. Now squeeze the water from the paper and paste each piece thickly on both sides, placing them one on the other to keep them moist. These pieces are taken up separately and pressed into the mould, which need not be filled level, but left hollow so long as the whole of the design is well carried out. Plaster-of-Paris is used for making the moulds. The design is first made in clay or cut in wood. Make a strong box a little larger than the model; pour into this box the wet plaster, and press in the model, having previously brushed the model over with a little sweet oil so that it will not adhere to the plaster. When the mould is hard set, line it with oiled tissue paper before pressing in the papier-mâché; allow this to well set and get partially dry before turning out. The mouldings may be fixed with needle-points and glue.

Vanadium.—This is one of the metals of the antimony group, and may be obtained as a greyish-white powder. It will decompose water at a temperature of about 90° C., and does not tarnish in the air. It is insoluble in hydrochloric acid, but dissolves rapidly in nitric acid and slowly in hydrofluoric acid. It burns readily and, in a current of chlorine, takes fire. It has been found in some iron ores, in copper-bearing beds in Cheshire, and in iron slag in Staffordshire. Its symbol is V, and its atomic weight 51·4.

Heating Greenhouse by a Flue.—In heating a small span roof greenhouse, 12 ft. by 8 ft. by 5 ft. to eaves, by a flue, the chief points to remember are that the horizontal portion of the flue must have a rise of 1 ft. in 10 ft., and the vertical part of the flue at the end of the rise must not be less in height than the length of the horizontal part. At the base of the vertical part there must be a soot door for sweeping, and also to admit of some burning shavings being inserted to start the draught, as will very likely be necessary whenever the fire is freshly lighted. A small furnace will do, and the flue, built of ordinary stock bricks, can be 7 in. by 7 in. inside. If the flue is carried across the 8-ft. end it will do, as close to the floor as possible. This will give a slightly different temperature at the two ends of the house, so that both half-hardy and very delicate plants can with care be accommodated.

Curing Goat's Skin.—Trim it on the flesh side with a sharp knife, and then well brush with a solution of 2½ lb. of alum and 1 lb. of common salt in 1 gal. of warm water; the skin should be treated two or three times with this solution on successive days. Now sprinkle bran all over the skin, brush out, and nail the skin to a board and dry it. As a preservative against insects, the flesh side of the skin may be treated with a mixture of arsenic and black pepper previous to drying on the board.

Inlaying Raised Frets in Finger-board of Guitar.—Get a small piece of a broken keyhole-saw, and insert it, teeth outwards, in a block of wood; this will cut a groove of uniform depth. The projection of the teeth must be correctly determined beforehand. The frets may be made of stout brass wire hammered carefully so as to partly flatten it.

Reeds of Organ Pipes.—These consist of a piece of hard-rolled brass, fixed by a wedge upon the flattened segment of a short cylindrical tube closed at one end, as ⊃. This is inserted in a solid block resting in an inverted cone of sheet metal (termed a boot) and supports a tube which reinforces the tone required.

Heating Schoolroom.—A schoolroom 66 ft. by 35 ft. by 22 ft. high has nearly 51,000 cub. ft. of space in it, which, with an ordinary area of window glass and good walls, can be heated by 9 ft. of 4-in. pipe per 1,000 cub. ft. of space. This will give 55° F. in very severe weather, and 60° F. at any other time. If 60° F. is required in severe weather, then 10 ft. of 4-in. pipe per 1,000 cub. ft. must be allowed. If 2-in. pipe is used, then double the length will be required. The advantage of 2 in. pipe is that 2 ft. of this only holds half the water that 1 ft. of 4-in. does, and this means getting the heat up in half the time after lighting the fire. If radiators are used, the heat can be got up still more quickly, as they hold the least practical quantity of water for a given radiating surface.

Putting Geneva Watch in Beat.—To see roughly where to put the hairspring on a balance so that the watch is in beat, after putting in a new hairspring, look at the opening in the cylinder; this should face the 'scape wheel. Usually there is a small dot on the balance rim against which the hairspring stud should be placed. To try finally, see that, when the watch is wound up, the balance when stopped by the finger has no more tendency to stop on one side than the other, and always starts off immediately it is released.

Repairing Hole in Boat.—Cut out the plank at the part and replace it with a well-seasoned piece, butting the remaining parts of the plank over a rib. If thought necessary, put in an extra rib or two, if the hole is above water-line. An easier method is to push the edge of a piece of sheet copper under the plank, double it over the hole, hammer it close, and tack down with plenty of copper tacks; the part should previously be painted. Cracks may be filled with a putty made of red lead, white lead, and copal varnish.

Soldering Spout on a Copper Kettle.—To re-solder a spout on a copper kettle, first thoroughly clean the copper where the spout is to be inserted with a piece of emery cloth, and also clean the spout around its large end. Then tin the copper inside the kettle where the spout is to be soldered, and also the spout, using killed spirits as a flux. Pass the small end of the spout through the hole from the inside of the kettle, and press it up so that the small flange on the large end of the spout butts against the side of the kettle; then solder round the spout on the inside of the kettle, and leave a thin body of solder floated smoothly round where the join occurs, the same flux being used as for the tinning. Solder composed of 1½ lb. of tin and 1 lb. of lead would be suitable for this purpose.

Clarifying Glue or Gelatine Syrup.—Decant it into a tall tank and let it rest for several hours, when most of the impurities will settle to the bottom, and, after decanting the glue, the bottoms may be added to the next boiling. If a large quantity of glue solution is to be treated, the heat contained in it will be sufficient to keep it fluid; but for a small quantity a jacketed pan must be used for clarifying. The addition of a very small quantity of alum to the glue solution is beneficial, as it coagulates the flocculent matter and renders it heavier. For gelatine, moist alumina would be suitable as a clarifying agent, or inert white powders, such as china clay or French chalk; these substances should be stirred into the gelatine solution and allowed to settle out. Experiments on the lines indicated should be tried on a small scale first.

Repairing Damaged Stonework.—It is presumed that the stone from which a piece has been accidentally broken is one of the Yorkshire "grit" stones, similar to that obtained from the Howley Park or Idle quarries For mending this kind of stone, mix resin and beeswax in about equal parts over a fire, or preferably over a hot plate, till both are thoroughly incorporated. Pour the mixture into water, and, after it has been well manipulated and allowed to cool, make it up into sticks. To unite the broken pieces, warm the stone, by means of hot irons, sufficiently to just melt the cement. Apply the cement to the fracture, then press tightly and firmly till set. This cement, however, has no lasting properties when exposed to the weather, but will answer for internal work. If the piece broken off is not too large, use Portland cement mixed with some of the pounded dust of the stone, and a little mineral oxide to give it the necessary colouring. This will make a far more satisfactory and lasting job.

Proportions of Sand and Lime for Mortar.—In mixing lime and sand by bulk, and not by weight, it is necessary first to ascertain the cubic feet contained in the lime, a cubic foot of which weighs 39 lb.; hence 5 tons × 2240 lb. ÷ 39 lb. = 287 cub. ft., multiplying this by 3, it is found that 861 cub. ft. of sand will be required, the weight of which can only be obtained by experiment, pit sand being given variously as from 90 lb. to 100 lb. per cub. ft.; river Thames sand, from 91 lb. to 102 lb.; river sand, 117 lb. to 118 lb., etc Thus, with sand at 90 lb. per cub. ft., 34½ tons will be required; with sand at 100 lb., 38½ tons; with sand at 112 lb., 43 tons; and with sand at 117 lb., 45 tons. About 8 tons of water will be required for slaking and mixing; there will result from 45 tons to 55 tons of mortar, varying both according to the weight of the sand used and the consistency to which the mortar is mixed. The exact weight can only be ascertained by experiment.

Enlarging Photographs without a Camera.—The best enlargements are made by utilising a room as a camera. The window should be blocked up with a screen in which should be cut an opening just large enough to be covered by the reversing back of the camera; outside the window, fix, at an angle of 45°, a white board or other reflector, which should be about three times the diameter of the reversing frame, but if the window has a clear view of the sky, the reflector may be dispensed with. Adjust the camera against the opening, with the lens pointing into the room, and insert the slide containing the negative, both shutters being drawn out. The picture should be focussed on a sheet of white paper or board placed on an upright easel or other support, the easel being moved and the lens racked out until the proper focus is obtained. Then cap the lens, place the bromide paper in position, and expose.

Autograph Moulds for Rubber Stamps.—To get a satisfactory mould, great care in all the processes is essential. Coat a piece of flat metal plate evenly with melted beeswax to a depth of about $\frac{1}{16}$ in. Before this has got quite hard write slowly what is required; make the pencil or stylus penetrate to the metal, quite through the wax, from end to end of the autograph. Clear out any shavings or chips of wax that may clog the writing. Sift some plaster-of-Paris through fine muslin; dry the powder in an oven, making it hotter than the hand can comfortably bear. Grind it up with a pestle and mortar to remove all traces of lumps, then sift again. Replace in the mortar and add enough water to make a thick cream, using the pestle to get thorough mixture and to leave no unwetted powder. Pour the cream upon the wax autograph and pat it with a light stick, so as to force the cream into the grooves of the writing. When the cream has set quite hard there should be a perfect facsimile. A similar procedure will obtain the true mould from the plaster facsimile.

Ink Eraser.—One kind is made by dissolving 1 part of oxalic acid in 10 parts of water. Another kind can be made by adding 1 part of chloride of lime and ½ part of strong acetic acid to 10 parts of water. Oxalic acid is a powerful poison, and should therefore be handled carefully. Chloride of lime solution should be kept in small closely stoppered bottles.

Thermo-electric Piles.—The simplest form is shown in Fig. 1. It consists of a number of strips, say of bismuth and antimony. These are joined, and alternate junctions, as 1, 3, and 5, heated as shown, while the other junctions are cooled. The action is very weak; for instance, for a single pair of these metals the electro-motive force is only about 120 microvolts $\left(\frac{120}{1{,}000{,}000}\text{ volt}\right)$ per degree centigrade difference of temperature between the junctions. Even this electro-motive force is lowered

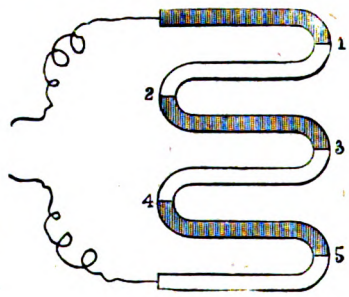


FIG. 1

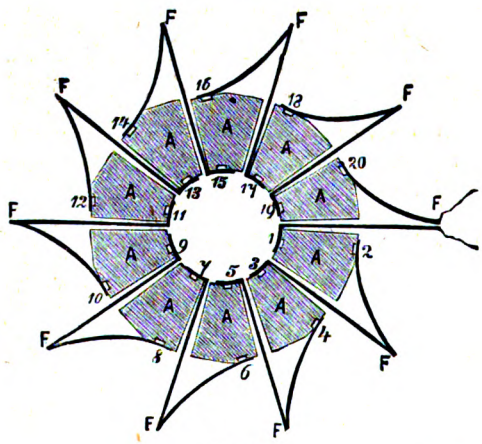


FIG. 2

antimony and lead the potential difference is the difference between ·000068 and 0, or ·000068 volts. The physical conditions of the metals have much effect on the voltage; thus, hard platinum is thermo-electrically negative to soft platinum. A section of Clamond's thermopile is shown in Fig. 2. The elements consist of block A, of an alloy (two parts tin and one part zinc), and arms of sheet iron F. The latter project and offer considerable surface to the air, so that the joints numbered 2, 4, 6, etc., to 20 are cooled. The inner junctions 1, 3, 5, etc., to 19 are heated, an earthenware cylinder with holes across it allowing coal-gas jets to play on the joints. Five such layers were used. Another form of Clamond pile is shown by Fig. 3. In this the hot gases from a coke furnace F pass up through the flues T, O, and P, and out at the chimney at A. The elements are shown at C, while copper radiators D attached to the outer junctions, but insulated from them, serve to increase the difference of temperature. It is said that from a battery with 3,000 couples the total electro-motive force obtained was 109 volts, the internal resistance being 15·5 ohms. The temperatures of the junctions were not stated, but 11 lb. of coke was burned per hour.

Pendulum and Rod for Dutch Clock. — The pendulums of Dutch clocks only weigh an ounce or two, and the bobs are usually made of turned wood about 2 in. diameter and ½ in. thick. The rod is of

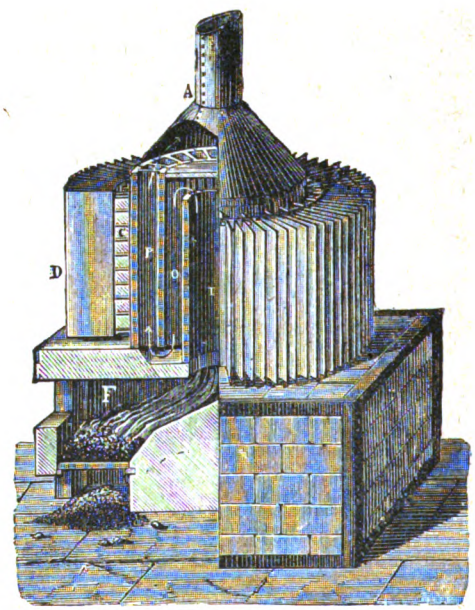


FIG. 3

Thermo-electric Piles.

by the "Peltier" effect, and the piles are racked by stresses due to expansion and contraction. The following table gives particulars of the thermo-electric properties of some metals, the electro-motive forces given being those obtained by junctions of the particular metal with lead, the difference of temperature being 1°C.

Metals.	*Electro-motive Force.*	*Metals.*	*Electro-motive Force.*
Bismuth ...	+ ·000068 volts	Lead ...	—
Nickel ...	+ ·000024 „	Copper ...	− ·0000017 volts
German silver	+ ·000015 „	Silver ...	− ·0000029 „
Aluminium	+ ·0000006 „	Zinc ...	− ·0000035 „
Tin	+ ·0000001 „	Iron ...	− ·000015 „
		Antimony	− ·000046 „

The current flows from the metal that is higher on the list; thus, comparing bismuth and antimony, from the first to the second. The value of the electro-motive force for any pair of metals is the algebraic difference of the numbers given in the table; thus, of bismuth and antimony it is the difference between + ·000068 and − ·000046 = ·000068 + ·000046 = ·000114 volt, and between iron wire, hammered flat at the top end and turned over into a hook. This is hung on a wire loop at the back of the clock for a suspension. The usual length is from 24 in. to 28 in. One should be made full length, and then shortened until correct. There need be no regulating nut, the wooden bob merely sliding on the wire rod friction tight.

Colouring Matter Used for Gelatine Photographic Films. — The colouring matters used depend on the purpose for which the plates are required. Eosine, alizarine blue, ceruline, etc., are employed. Eosine is generally used for isochromatic plates. This colour fades in direct sunlight, but would not do so in the fraction of time required for exposure.

Dry-cleaning Valencia Waistcoat. — To dry-clean a striped Valencia waistcoat and lining, cut 2 oz. of Sunlight soap into shavings, and pour over it 1½ pints of boiling water in which is placed a small piece of alum. Beat this into a lather and leave to cool. When cool it will be the substance of a jelly. Apply this to the waistcoat with a close sponge: do a few square inches at a time. With another sponge, wash off the substance with a very little tepid water. Then squeeze the water from the sponge and dry the material. Repeat this process till the vest is finished. Then hang it up until thoroughly dry, and dry-press.

Lining Out Cart Wheels.—When lining out a cart wheel one of the best ways is to tilt the horse back, by putting a block underneath the front part, to any angle required (being careful not to overdo it, or wheel and horse will overbalance), then gently revolve the wheel, gauging the lines on in the usual manner. By this method there is not so much chance of getting jumps in the lines as when done on a box. The fronts of the spokes can also be done when in this position; the stock should be done with the wheel on the horse in its ordinary position. If, after lining the surface, it is uneven, take some glasspaper and cut down the ridges caused by the lines, and give another coat of paint. The prices of colours vary according to quality, but for experimenting a green is best; this can be mixed to so many shades, and various colours in lines blend well with it.

Making Opaque Coloured Glass.—Opaque glass or enamel may be made by adding white insoluble substances to the ordinary flint or soda glass while it is in a melted condition. Bone phosphate or bone ash and barytes are most commonly used, but cryolite, white arsenic, and oxide of antimony are also employed. To render the glass dull, add to it as much as possible of either bone ash or barytes consistent with proper working and to keep the temperature high while it is stirred into the glass. The colours used are the same as for transparent glass, but more colouring matter is required to give intensity on the white base. For blues, cobalt oxide, smalt, or black oxide of copper are employed; for violet, oxide of manganese; for ruby, oxide of gold, suboxide of copper; for emerald green, copper oxide and oxide of iron, chromium oxide (chrome green); for yellow, uranium oxide, oxide of antimony, etc.

Ink-pad for Rubber Stamp.—To make a pad, cut from the lid of a cigar-box a piece of wood of the desired size. Upon this place several thicknesses of sheet-cotton cut to size. A stretch of fine woollen cloth and a top or surface of linen (a piece of an old handkerchief is excellent) is now put on. The two latter coats must be long enough to come well over the wood round the edges. Finally, tack on a binding of leather or tin. If a lid of a tin is handy, it is a good plan to make the pad to fit into it.

Making Painters' Knotting.—To make a gallon of knotting, as used for painting knots in new woodwork, ½ lb. of powdered shellac is dissolved in 1½ gal. of methylated spirit; to do this, place it in a warm place, and frequently agitate it. Made this way, it will require shaking up before being used. This is the patent knotting of commerce, to which, however, something is added to keep the shellac in solution. It will not pay to make it, patent knotting being much superior. Where patent knotting is not available, French polish will answer the purpose of stopping-out the knots.

Length and Weight of Clock Pendulums.—There is no rule as to the weight of a clock pendulum; it is regulated according to the quality of clock. The best clocks carry the heaviest pendulums. Weight does not affect the time of vibration; that depends solely on the length. There is no formula for determining the friction or resistance to the air of a pendulum. To find the length of a pendulum for any given clock, first find the number of vibrations it is required to make in one minute, and then find the length of a pendulum making that number either from a table or by calculation. To find the required number of vibrations per minute, multiply together the numbers of the teeth in the centre wheel, third wheel, and 'scape wheel. Divide this by the numbers of the third pinion and 'scape pinion and 30. Thus, suppose the centre wheel is 64, third wheel 60, pinion 8, 'scape wheel 30, pinion 8, then $\frac{64 \times 60 \times 30}{8 \times 8 \times 30} = 60$ = number of vibrations per minute. To find the length of the pendulum making this number of vibrations per minute, divide 375·4 by the number and square the result. Thus $\frac{375{\cdot}4}{60} = 6{\cdot}26$; this squared = 39·18, which is approximately the length of the seconds pendulum in England.

Pipes Required to Heat Drying-room by Steam.—The quantity of pipe required depends on the pressure of steam available. With a low pressure, say 10 lb. per square inch, to obtain 150° Fah. 150 sq. ft. surface of steam pipe per 1,000 cub. ft. of space will be wanted. The room has just over 10,000 cub. ft. of space in it, and therefore requires 1,500 sq. ft. of heating surface, or, say, 2,850 ft. of 2-in. pipe. This is supposing the ventilation to be free. With high-pressure steam, considerably less pipe will suffice. A single 2-in. pipe all round would scarcely suffice to heat the room 55° without the full degree of ventilation that is needed in drying-rooms. Wrought-iron pipe should be used.

Dyeing Light Cloth Black.—Put 10 lb. of logwood and 3 lb. of bruised galls in 3 gal. of water; boil for two hours, and strain. Place the coat in the dye, and allow it to remain for half an hour. Take it out, and add about 2 lb. of copperas. Replace the garment, and boil till the dye has thoroughly impregnated it: the time this will take depends on, among other things, the quality and original colour of the coat. Remove it, and hang up for an hour; then rinse it twice, or three times, in cold or slightly warmed water, and dry. Sometimes a garment requires a second or a third dipping. Finish by pressing into shape. Common or old cloth will not stand much boiling, and pure woollen goods have to be treated with extreme care.

How to Preserve Blown Eggs.—To prevent birds' eggs cracking or crumbling after they are blown, well rinse them out with corrosive sublimate dissolved in spirit of wine (a few grains to the ounce); this is a deadly poison. Insert a small quantity into the egg by means of a glass egg-blower with a bulb, then shake the egg so that the solution comes into contact with all the inside skin. Now draw the solution out of the egg by the blower, and return it to the bottle. Now place the egg with the hole resting upon blotting-paper, so that the last drop or two may be drawn out, and finally cover the hole with a small piece of gummed paper. Water containing a few drops of oil of cloves may be used in place of the sublimate if desired.

Concrete to Cover a Brick-paved Floor.—The materials used should be broken bricks, clean sharp sand, and Portland cement, in the proportions of 6 parts aggregate to 1 part cement. An area 16 ft. by 1½ ft. by 2 in. contains 3½ cub. ft., or about 1½ cub. yd. The quantities required will be about 1 cub. yd. of broken bricks of the size of a walnut, 1 cub. yd. of sand, and ¼ cub. yd. of cement, or say about 7 cwt. These materials should be well mixed together in a dry state, a minimum quantity of water applied from a water-can with a rose nozzle, and carefully laid to the desired level, being worked with a trowel until the cement creams on the surface and the whole is even. Only a small quantity should be wetted at one time and before a start is made the existing brick floor should be well brushed with a stiff brush, until all dirt, moss, etc., is entirely removed and the bricks are clean.

Cream-coloured Paint for Table Oilcloths.—For a paint for table oilcloths, try white lead or zinc white ground in oil, with 4 oz. of patent driers to the pound, and enough boiled linseed oil to make it flow. This paint should be applied in a warm room and dried rapidly while hung in a room heated by flues running along the floor. The cloth should previously be coated either with a thick boiled starch or with glue size.

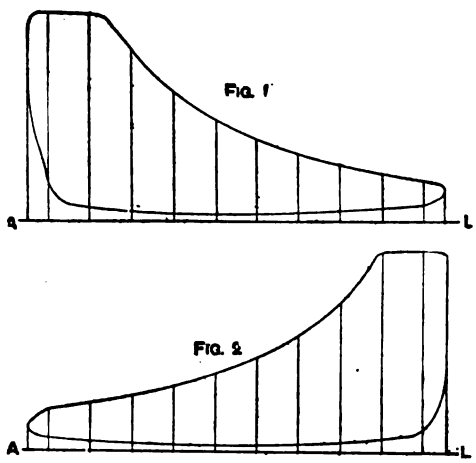
How to Make Sarsaparilla Beer.—Dissolve 1½ oz. of compound extract of sarsaparilla in 1 gal. of hot water, and when the solution is complete stir in 2 lb. of moist sugar. When the liquid is lukewarm, stir in a wineglassful of brewer's yeast and keep in a warm place overnight. Next day, skim off the yeast, strain the liquid, and bottle; tie down the corks, and leave for a week to become brisk. Instead of the extract, ½ lb. of sliced sarsaparilla root may be used, but this will have to be boiled with the water; 1 oz. of liquorice root and ½ oz. of aniseed added to the beer are considered by some an improvement.

Ebonising Pine.—To ebonise pine, take 1 gal. of water, 1 lb. of logwood chips, ½ lb. of copperas, ½ lb. of extract of logwood, 2 oz. of indigo blue, and 2 oz. of lampblack. Put into an old iron pot and boil slowly. When cold, strain through canvas, then add ½ oz. of powdered nut galls. Or take 1 gal. of vinegar, 2 lb. of extract of logwood, ½ lb. of green copperas, 2 oz. of China blue, and 2 oz. of nut galls. Boil over a slow fire. Give at least two coats with an old brush. When dry, intensify the black by brushing over with iron solution, made by steeping a good handful of iron filings or rusty nails in ½ pt. of vinegar; smooth down with glasspaper, then fill in the grain with a filler made of finely crushed whiting, lampblack and turps made into a stiff paste; finish with polish—to make which add to 1 pt. of methylated spirit 4 oz. to 6 oz. of best orange shellac and ½ oz. of black aniline spirit dye.

White Ground for Drawing Boards.—To obtain a white ground on drawing boards so that drawings made with charcoal and coloured chalks may be easily rubbed out, mix dry white lead to a stiff paste with gum arabic dissolved in water; add water till it works easily, like paint. When applying it, either stipple it with a hog-hair brush or cross and re cross it till no brush marks are seen. A little of the white should first be tried on the corner of the board. Let it dry, then rub the fingers over it. If it rubs off on the fingers, add more gum; if it shines, there is too much gum. To dissolve the gum, saturate it with water and stand in a warm place.

Matt Surface on Photographic Prints. — To obtain a matt surface on photographic prints, matt P.O.P. should be used, this giving the finest results. But a matt surface can be given to an ordinary glazed print by squeegeeing it on to the rough side of a piece of ground glass, the mode of procedure being the same as that for producing a highly glazed surface on ordinary glazed P.O.P., substituting ground glass for the ordinary glass or other polished surface.

Determining Power of Engine from Indicator Diagrams. — To calculate the horse-power of an engine from diagrams, each diagram should be marked off, as shown, by ten lines perpendicular to the atmospheric line A L. The extremities of the diagram are marked on the line A L and the distance between divided into twenty equal parts, perpendicular lines being erected at the first division, third division, fifth division, and so on. The diagram cuts each of these lines in two points, and the distance between these points should be measured to obtain the effective pressure shown by the card at that line. This, however, is not the effective pressure on the piston at that point in the stroke; to obtain this the two cards, front and back, must be superposed, and the back pressure shown on one deducted from the forward pressure shown on the other. This, however, has no effect in the mean pressure as obtained below. The pressure as obtained from the diagram depends on the spring used. On cards with which a $\frac{1}{4}$ spring is used a length of 1 in. shows a pressure of 40 lb. per square inch; so that a length of

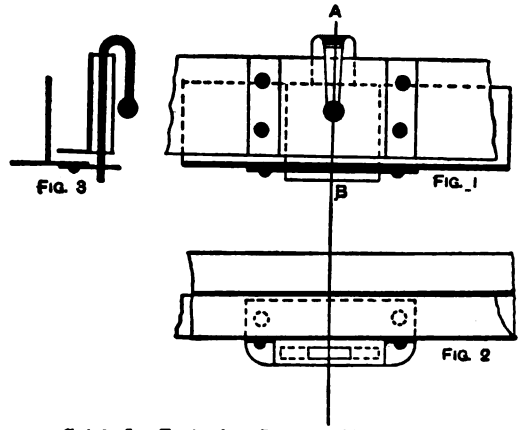


Determining Power of Engine from Indicator Diagrams.

1¼ in. on the diagram would indicate a pressure of $1 \times 40 = 65$ lb. per square inch. Owing to reduction, the actual scale of the illustrations is $\frac{1}{16}$, or 1 in. = 80 lb. per square inch. Measured in this way, the pressures are, commencing from the left in Fig. 1, 68, 80, 60, 50, 40, 32½, 25, 18½, 15, and 10 lb. per square inch, and, in Fig. 2, 10½, 15, 20, 25, 30, 35, 45, 55½, 71½, and 72½. The mean of each of these is their sum divided by ten. Thus the mean pressure shown by Fig. 1 is $\frac{399}{10} = 39{\cdot}9$ lb. per square inch, and by Fig. 2 is $\frac{386}{10} = 38{\cdot}6$ lb. per square inch. The mean pressure during the two strokes may therefore be taken at $\frac{39{\cdot}9 + 38{\cdot}6}{2} = 39{\cdot}25$ lb. per square inch. The horse-power may now be determined.

Flat-flame and Bunsen Gas Burners Compared.— Comparing the heat given off by gas burnt in an ordinary gas-burner and that burnt in a Bunsen burner, Professor Lewes states that a luminous flat-flame burner gives a temperature of 2,462° F., and an ordinary Bunsen flame a temperature of 2,732° F., while by increasing the quantity of air until the flame is on the point of flashing down the tube the temperature rises to 2,966° F.; in ten experiments the amount of gas consumed is not stated. A Bunsen burner consuming 4 cub. ft. per hour will require about 36 cub. ft. of air per hour, while the air would be contaminated to the same extent by both descriptions of burner, since the total amount of gas burnt and consequently the products of combustion given off would be the same in both cases. When the gas is mixed with too much air it forms an explosive mixture. With regard to the proportioning of the gas and air supplies of Bunsen burners, the information on this point is mainly due to the labours of Mr. T. Fletcher, F.C.S., the well-known gas-stove maker of Warrington. In a paper read before a meeting of the Gas Institute in 1883, Mr. Fletcher states "that the mixing-tube [of a Bunsen burner] if horizontal should not be less in length than four and a half times or more than six times its diameter." With regard to the diameter of the mixing-tube, "with large flames, given a certain size of gas jet, the diameter of the mixing-tube should not be less than ten times as great." "Given a certain area of tube delivering a combustible mixture, the outlet for this mixture must be neither more nor less than the size of the tube." "The variation from the rule, however, must be a matter of experience with each form of burner. There is also the fact that with small divided flames it is not necessary to mix so large a proportion of air, as each flame will take up air on its external surface; but in this case the flames are longer, hollow, and of lower temperature. As a matter of actual practice, where a burner is used which gives a number of separate flames or jets the diameter of the mixing-tube does not need to exceed eight times the diameter of the gas jet, the remainder of the air required being taken up by the surfaces of the flames." It will be seen from the foregoing that it is advisable to regulate the air openings according to the quantity of gas passing.

Catch for Fastening Door of Street Lamp. — The diagrams show a catch suitable for a large lamp. Fig. 1 is a front elevation of the angle iron



Catch for Fastening Door of Street Lamp.

forming the bottom of the door, with a small rectangular box riveted upon it, in which a flat bolt is arranged, so as to slide up or down. Fig. 2 is a plan of the T and angle iron, box with slot in top and opening at bottom, and also an iron plate riveted on the underneath side of T-iron, a slot being cut in this for the bolt to slip into to fasten the door. Fig. 3 is a section on the line A B, showing the position of bolt in box, and projecting plate on T-iron with slot for bolt to enter.

Use of the Box Sextant in Surveying.—The box sextant is an instrument about 3 in. in diameter, to be held in the hand, for ascertaining approximate angles between any given stations. It is made with or without a telescope, and is in general appearance like Fig. 1. An enlarged diagrammatic plan is shown in Fig. 2, where A is the sight hole of the telescope; B is a fixed glass, the lower half silvered and the upper half plain; C is a mirror attached to the same pivot as the vernier arm D. The side of the case is open at E and F to admit the rays of light from the observed objects. The required angles may be between station poles, church spires, or any other definite lines or points. Suppose a single pole be looked at, the angle indicated should be 0° or zero; whether it will actually be so or not depends upon circumstances which the following remarks will explain. Suppose a pole to be fixed at G, which, bearing in mind the scale, would be abnormally close, it can be seen through the clear part of the glass at B on applying the eye to the sight hole at A. At the same time the rays of light from the pole G will be streaming in all directions, and some of them will pass along the dotted line direct to the mirror C, and, when the vernier arm is placed in the position shown by the dotted line, the rays of light will be reflected to the silvered part of the glass B, and from thence to the eye at A, the appearance being as of one continuous pole

down the two parts of the glass. If the vernier be now examined, it will be seen that the broad arrow falls short of the zero of the scale owing to what may be called the width of base line of the instrument. If the pole be placed farther off as at H, the rays of light following the stroke-and-dot line will require the vernier arm to be shifted rather nearer the zero of the scale; but until the pole is at a distance of two chains from the observer there will be a similar error of less and less

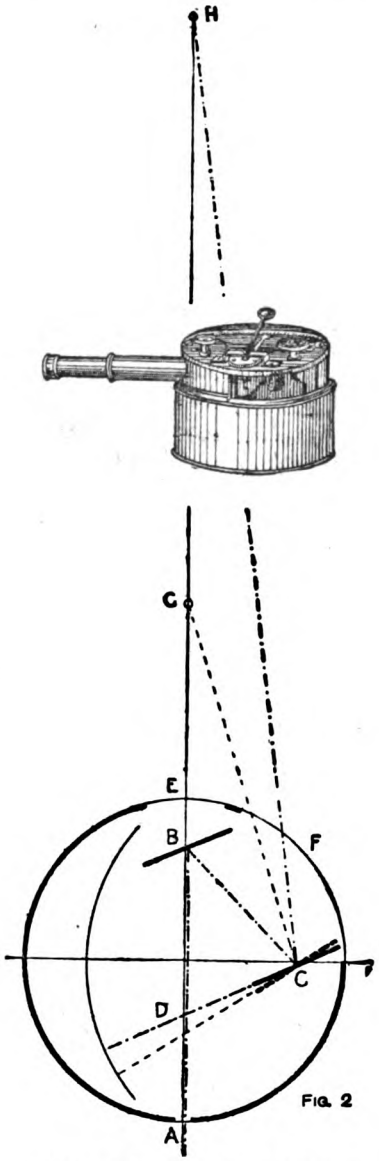
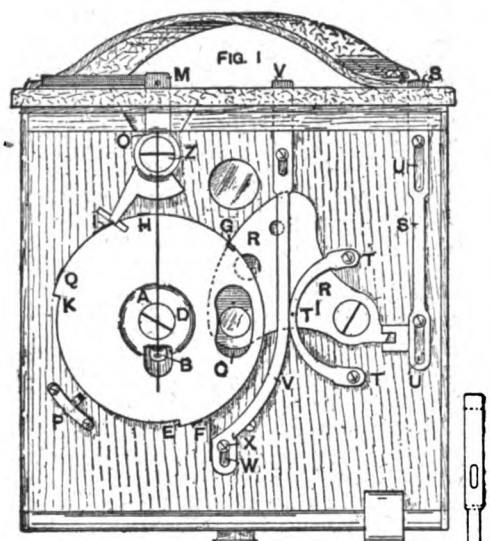


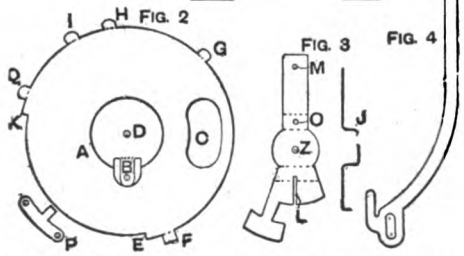
FIG. 2

How to Use the Box Sextant.

amount. Between two chains distance and an infinite distance the rays of light from the pole to B and C are now so nearly parallel that the error is under one minute of arc, so that the instrument can be used without difficulty under those conditions. It is usually adjusted by sighting it to the sun, which should appear through the smoked glass as a perfect sphere in whatever way the sextant may be held when the vernier is at zero. When an angle is to be taken at one station and between two others, the nearer station should be viewed through the plain glass, so that the sextant may need to be held upside down. When the angle to be read exceeds 90°, an intermediate pole should be set up and the angles taken in two portions, as in viewing large angles the mirror C is moved so far round that its reflection, and that of the image it carries, is viewed almost edgeways in the mirror at B. The vernier arm is moved by means of a milled head screw on the top of the case. It should be noted that the box sextant only gives angles in the plane of the instrument, so that if the stations observed are not on the same level, the angle given will be the direct angle between them, and not the horizontal angle such as would be given by a theodolite.

How to Make an Everset Photographic Shutter.—A shutter suitable for use with a single lens at the diaphragm (as employed in the bull's-eye kodak, and shown complete at Fig. 1) may be made as follows:—Cut thin brass or zinc to the shape shown by Fig. 2. The centre part A is punched in, and upon it the shutter or circle turns. The projections are turned up, and the part B, after being pierced and cut round, is turned up on the dotted line. Now cut the releasing arm (Fig. 3) in the metal, bending in the dotted lines to the form J. Note the slot L. Around the screw or pin fitting the screw hole M





How to Make an Everset Photographic Shutter.

goes one end of the steel wire shown in Fig. 1, which passes from it through O across L, and very loosely through the large hole in B. The fixing of the shutter is shown in Fig. 1, and when attached to the camera front by a broad-headed screw through D and another at Z, the catch P is fixed in the correct position. Through the arm the wire pulls the shutter round when out of the way of projection Q or G. As the shutter stands away from the front, space is left for the diaphragms between it and the lens. These consist of three holes formed in the triangular plate R worked by the arm S and guided by the semicircular piece T. The position of the first and last diaphragm is governed by the slot U, but the middle one is centred with the lens by having a dent T^1 in R, which receives a similar projection (the under part of the dent) in T. For time exposures the arm V (Fig. 1), also shown at Fig. 4, is lifted, the slot W passing around the screw X, and when raised it meets the projection F, and, on pressing the release in the opposite direction, it returns. Projections H and I then come into use. The method of bending the arm may be gathered from Fig. 1, which shows the shutter set for an instantaneous exposure, it having travelled halfway.

Method of Hinging Screen Frames.—It is often difficult to decide which is the best and cheapest way of hanging screen frames. A screen should be hinged so that it will close both ways, but the expense of the double folding joints made specially for that purpose is too great to admit of their frequent use. The following describes a cheap, simple, and efficient substitute. Assuming that the frames are ready for hanging, and that the screen consists of four frames, there will be three separate hangings, which will require six laths laced together in pairs, as shown. The laths should be sawn out of a ¼-in. board the full height of the frames, and if the thickness of them is ¼ in., the laths should be ⅛ in. wider, to allow the screen to close flat together without any strain. Gauge and plane up the laths both in width and thickness, neatly finish off the ends so that all of them are exactly the same length, and, to prevent the sharp edges cutting the tapes, rub them well off with sandpaper. They are now ready for painting, staining, varnishing, or polishing, as may be preferred. When they are dry, proceed to put on the tape, which may be got in various colours from ½ in. to 1 in. wide; about 3 yd. will be required for each pair of laths. Mattress binding is good; being made of linen it does not

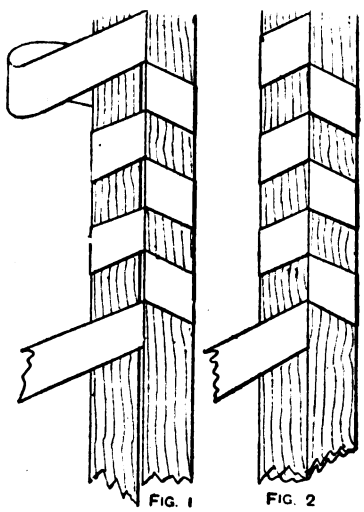


FIG. 1 FIG. 2

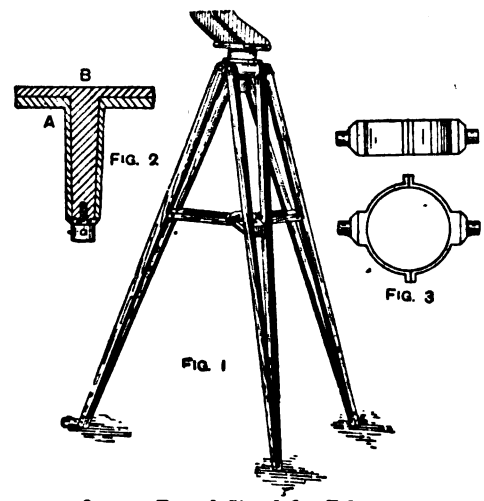
Method of Hinging Screen Frames.

stretch. Begin by tacking the end of the tape to the top end and under side of one of the laths in an oblique direction; lay the two laths together, pass the tape up between them from the under side, and lace them together rather loosely, over and under, first left, then right, and leaving a loop as shown at Fig. 1. When sufficient turns have been put on to reach the bottom, begin again at the top to pull the laths tight together, turn by turn, and regulate the distances; fasten the end off at the bottom to the underside, as before. It is of great advantage to hold the two laths edge to edge in the bench-screw while pulling the tape tight, as it leaves both hands at liberty to manipulate it. Proceed now to hang the frames together; bore four holes in each lath, at equal distances between the tapes, neatly countersink for screw-heads, and screw them to the edges of the frames. This joint has a very pleasing effect if it is neatly done and the tape is made to harmonise with the material on the frames. It is very durable, draught- and sight-proof, and can, if necessary, be renewed at a very small cost of time and money.

Transferring Photographs to China, etc.—To finish off a photograph so that it will look like china without enamelling, several simple methods of transferring are available. Among these is the use of Eastman Transferrotype paper, and various makes of stripping P.O.P., which are to be had of photographic dealers. Ordinary P.O.P. may also be used, but the result is somewhat uncertain. In the case of ordinary P.O.P., thoroughly wash the article to which the photograph is to be transferred, then coat it with a weak solution consisting of gelatine 10 gr., water 1 oz., and bichromate of potash 5 gr. Crush the bichromate, and add the gelatine last. Expose the coated side to the light, and wash for some hours. Take a very darkly printed proof finished and dried, but not alumed, soak it in cold water, and then place on the article to be decorated; squeegee the print thoroughly into contact, and dry. Now pour on hot water till the print blisters badly, when the paper may be stripped away. If the water is too hot, the gelatine will melt. Great care must be taken not to move the print, which should be laid flat; and when dry a coat of copal varnish should be applied, and the article baked. It will then stand careful washing.

Boring a Railway Tunnel from Both Ends.—In the construction of railway tunnels it is usual to work from both ends, and sometimes from intermediate points also. The line of route is laid out on the surface to facilitate observations underground; but if this is impossible the extreme points have to be connected by accurate trigonometrical surveys and exact levels, so that their relative positions are precisely known. The centre line at formation level is then accurately set out by theodolites and standard chains, a smaller heading being driven in advance of the main tunnel, so that (apart from facilities of construction) in the event of a slight error in meeting the heading from the other end, the directions may be adjusted.

Garden Tripod Stand for Telescope.—A cheap equatorial stand that does not require much lathe work in its construction must have an axis on which to

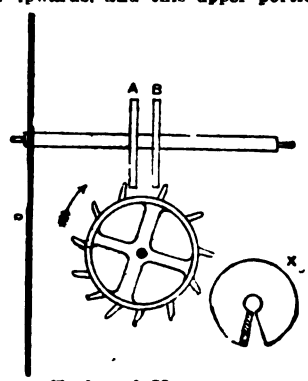


Garden Tripod Stand for Telescope.

rotate, to provide the horizontal motion; the vertical motion being provided by a metal clasp having two trunnions, which rotate on wooden uprights provided with V-shaped bearings. This mounting is supported by a wooden tripod stand similar to the ordinary camera stand, though, of course, more substantial and rigid. It can therefore be used either indoors at an open window or in the garden. In the tripod shown in Fig. 1 the three legs are bolted to a wooden base and provided with three cheeks for the purpose. Under the base, about halfway down and connecting the three legs together, is a sort of a double joint, which folds upward when the stand is not in use. When open, this drops and keeps the legs stationary. Above the base, and glued and screwed to it, is a circular, cylindrically shaped block having a hole through its centre to receive a female cone of metal. A recess in the block receives the shoulder at the top, which is then screwed down to the block. This cone is shown in section at A (Fig. 2). A cone, shown at B, is similarly screwed to the oblong stage of wood above the block, to which the uprights are screwed. The two centres are ground together, and, when fitted accurately, are held together by a screw and washer at the ends. The uprights, shaped as in the illustration, carry the clasp by its trunnions, the clasp being screwed around the body tube of the telescope. The clasp is a metal casting about 2½ in. deep, with two circular trunnions and two rectangular wings. This is shown in elevation and plan at Fig. 3. When the hole has been turned to fit the tube, and the trunnions turned exactly equal to each other in diameter and fitted between the uprights and to the V's on them, the rectangular wings are drilled for four screws, two at each wing. The ring is then severed into two halves, the saw cutting through the wings. Some blotting paper is then pasted in the curves of each half, to prevent the disfigurement of the lacquer work on the body tube, and, when dry, the clasp is screwed together around the tube. In this way the two horizontal and the vertical motions are supplied.

Time for Photographic Exposures.—All photographic exposures being somewhat in the nature of an experiment, because of the ever-varying conditions of the atmosphere, it is possible only to give approximate times. Over-exposed plates may be corrected by careful development; but a very much under-exposed plate is past remedy, and a slow plate is more easily dealt with than a fast one. As a rough guide to a beginner, exposure meters may be of service, but, if followed too slavishly, they may prove worse than useless. The following is the minimum exposure for June, 11 a.m. to 1 p.m.:—Clouds, $\frac{1}{25}$ sec.; sea and sky, $\frac{1}{50}$ sec.; open landscape (distant objects only), $\frac{1}{4}$ sec.; buildings (well illuminated), $\frac{1}{2}$ sec.; groups (light dresses), $\frac{1}{2}$ sec.; groups (dark and heavy contrast), 1 sec. It is impossible to classify interiors as light and dark to be of any use. The only practical plan is to make a trial exposure and develop the plate. If it is impossible to develop a trial plate, make several exposures of different lengths. In all exposures the colour of the light and the degree of contrast in the subject and that required in the picture must be taken into account. It may here be mentioned that one would hardly attempt clouds, sea, or sky in the middle of the day. Bear in mind the old rule, "Expose for the shadows, and let the lights take care of themselves."

Clockwork Metronome.—To make a clockwork metronome, a pendulum must be employed. The usual arrangement is to have a short lead bob pendulum, about 3 in. long, pivoted upon an arbor. The rod is extended upwards, and this upper portion is fitted

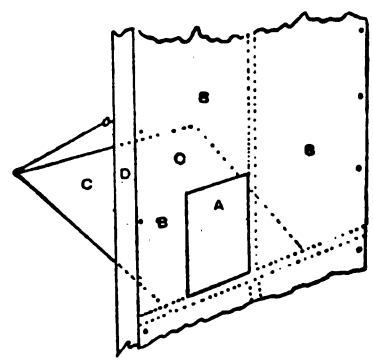


Clockwork Metronome.

with a sliding weight to adjust the speed. The higher the top weight is raised the slower the pendulum goes. The escapement is shown in the accompanying sketch. The 'scape wheel teeth are straight pins, and they rest upon two flat steel discs fixed on the pendulum arbor. These discs are cut, and the edges bevelled off, to give the impulse alternately in each direction. Thus, one of the pins of the 'scape wheel falls upon the face of disc A and, passing the bevelled edge, gives the pendulum an impulse to the right and falls upon the second disc B. As the pendulum returns, this tooth gives impulse, by means of the bevel on B, in the opposite direction to A, and the next 'scape tooth falls upon A, and so on. An American drum-clock train will do. The 'scape wheel must be taken away, and the next wheel before it converted into a 'scape wheel by breaking out some of the teeth, leaving one in every three, and bending them forward a little.

Protecting Exposed Water Mains from Frost.—There are incorrect ideas as to how a bad heat-conducting material protects pipes from frost. Water absorbs and holds heat, but the heat is readily dissipated, or radiated, or becomes absorbed by cold air or substances with which it comes in contact, the consequence being that its temperature is reduced below 32° and the water becomes ice. The purpose of a bad heat-conducting material is to form a barrier to this heat transference, so that should the water be, say, 50°, the air and general surroundings can be much lower in temperature without reducing the heat of the water in any marked degree. The covering, therefore, does not afford any heat whatever, but prevents heat passing through it. Coverings, however, to be as effective as this would require to be of materials which are perfect non-conductors of heat, and this is not as yet possible. There are some very effective bad conductors, almost non-conductors, and the two best are undoubtedly hair felt and silicate cotton (slag wool). Both vary in effectiveness according to the thickness of the covering. If hair felt is used it can be $\frac{1}{2}$ in., but $\frac{1}{4}$ in. is better for good work. It should be cut in strips and be wound on the pipes soundly; but it is best not to bind it on too tightly afterwards. It should be secure, but not compressed. The silicate cotton is usually a loose material, and requires to be placed in a casing. It can, however, be obtained sewn on to canvas. Probably any one of the patent compositions used for jacketing steam boilers would answer the purpose. The coating should afterwards be lagged with narrow boards secured with iron belts or bands, or be covered with canvas and painted, tarred, or otherwise protected from decay through damp or by atmospheric corrosion.

Simple Method of Copying Negatives for Lantern Slides.—The following is a simple way to make lantern slides by reduction, the ordinary camera and lens being used, supported preferably on a table:—First make a carrier to hold the lantern plate in the dark slide by tongueing together, to form a frame, two pieces of $\frac{1}{4}$-in. wood 4$\frac{1}{2}$ in. by 1$\frac{1}{2}$ in., and two similar pieces 6$\frac{1}{2}$ in. by $\frac{1}{4}$ in. Rebate the inner and outer edges on opposite sides $\frac{1}{16}$ in. Thoroughly clean a window pane and place the negative for reduction (A) film towards the camera in one corner. Fasten in position safely with two drawing pins. Outside the window D suspend at an angle of 45°, to act as a reflector (C), a sheet of white cardboard at least four times the size of the negative. Fasten at the bottom and attach string to the two top corners. In a large sheet of brown paper B cut a hole A just large enough to expose the whole or the desired portion of the negative. Pin this up and fasten curtains across the top of the window. Build the camera up level with the boxes, focus very sharp, and



Apparatus for Making Lantern Slides.

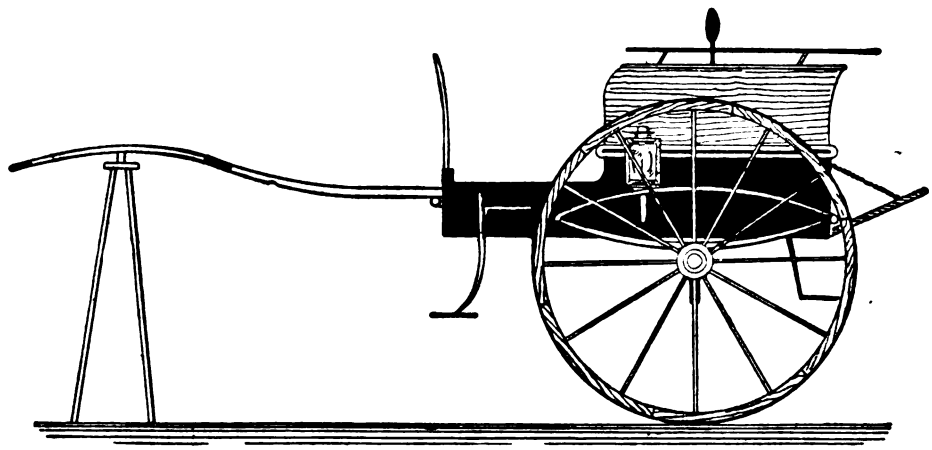
expose as usual. The centre of the plate must exactly coincide with the centre of the negative, and the corners should all be equidistant, otherwise the lines will be distorted. No special lens is required. When a clear view of the sky is obtainable, a lidless box, having an opening in the bottom capable of receiving the negative and corner pieces to prevent it falling through, may be attached to one end of a board; at the other end is the camera. The board at the box end is fastened to the window sash with eyes; the other end is suspended with string so that the negative points to the clear sky and even illumination is ensured.

Making Wax Candles.—Wax candles are made in machines each capable of moulding fifty or one hundred candles at one time. The machine is simply a framework holding a large tray having a number of circular holes. Under each of these holes hangs a candle mould with the point downwards. The wicks are wound upon bobbins below, drawn through the points of the moulds, and then stretched tight by fixing to a frame above so that they pass up the centres of the moulds. Surrounding the moulds is a trough. The molten wax is poured into the tray, from which it falls into the moulds. Cold water is then run into the trough, and the wax immediately solidifies. The excess of wax in the tray is removed by a scraper, and the frame carrying the wicks is raised so that all the candles are drawn out of the moulds. The wicks are then cut and the process repeated. The waxes used are paraffin wax, composite (paraffin wax with 5 to 15 per cent. stearic acid), cerasin, etc.

Colouring a Malacca Cane.—To colour a malacca cane, mix some spirit aniline dye in thin spirit varnish. Bismarck brown yields a rich red; yellow may be obtained in various shades, but must be very strong in order to gain a good colour, unless the upper surface of the cane is removed by the aid of No. 1 glasspaper. The cane may be finished with clear spirit varnish, though better wearing results would be gained by a thin, even coat of best quality coach varnish.

Properties and Use of Picric Acid. – Picric acid is formed by the action of nitric acid upon phenol (carbolic acid). Picric acid is a pale yellow crystalline substance sometimes used in dyeing, as it yields a fine pale yellow upon silk. It is principally used in the preparation of some of the "high" explosives. It does not explode by applying a light or by friction, but when a strong detonating cap is exploded in a cartridge of picric acid, the latter is caused to explode with terrific violence. The combinations of picric acid with soda and potash are amongst the most powerful explosives, but as they sometimes explode spontaneously, they are rarely used.

Small Cart for Pony.—A cart suitable for a pony from 11 to 12 hands high is shown below. The length of the body is 4 ft. at the bottom and 2 ft. 6 in. on the seat. The bottom panel sides are 10½ in. deep under the seat and 7 in. at the front. The front board is 8 in. deep. The top sides are 1 ft. deep, and are bent over sharp at the top, each being fastened with two half-round irons in addition to being screwed from outside to pieces that the seat slides on, which, with a cross-bar, are of birch or oak 1 in. thick and 3½ in. wide before being



Small Cart for Pony.

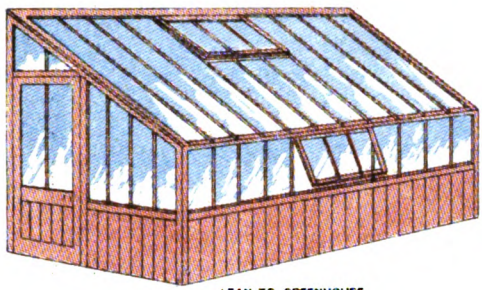
dressed. These bent sides can be made of ¾-in. walnut finished in plain varnish, and give a nice contrast to the black japan on the bottom panels; a piece of wide wood bead, having a strip of plated bead fastened along the centre, going over all. The bottom of the body is 3 ft. wide, and may be made either quite square or, if preferred, spread out each side 1 in., when 2 ft. 10 in. will be wide enough for the bottom. The bottom boards are 1-in. deal. The simplest way of putting the cart together is to screw a batten along inside either side and nail the boards to these, having a good bar of 1-in. ash at back and front, and underneath all is nailed a couple of pieces of hoop-iron. The elliptic springs are 3 ft. long, with four plates 1¼ in. wide. They are fastened to the body with angle-irons and blocks 1 in. deep by 4½ in. long. The 1½-in. axle is cranked 4½ in. deep. The dash is 22 in. long and 15 in. high; wings, 6 in. wide, ⅛ in. thick, and 2 ft. 6 in. long; wheels, 3 ft. 6 in. high; stocks, 7 in. by 5½ in. diameter. There are twelve 1¼-in. spokes; felloes finish 1¼ in. wide by 1½ in. deep; tyres, 1½ in. wide. The shafts are 4 ft. 10 in. long in front of splinter-bar, and 1 ft. 8 in. wide at tugs, which are 14 in. from points; they go inside the body, and are fastened in rubber bearings at the front and with a long cross spring at the back. If required rather stronger for rougher usage, have the stocks 6 in. or 6½ in. diameter, and spokes ½ in. and felloes ¾ in. larger than the measures given. In this case the springs might have another plate added with advantage.

Kallitype Process in Photography.—The Kallitype process of printing is the subject of a patent. It consists of first coating any fairly pure paper with a mixture of silver nitrate and ferric oxalate. The ferric oxalate is reduced to the ferrous state by the action of light, and thereby reduces the silver in contact with it, thus forming a visible image, which is simultaneously developed and toned, and afterwards fixed. Dissolve 70 gr. of ferric oxalate in 1 oz. of distilled water, and add 15 gr. of silver nitrate. Brush this solution with a sponge or tuft of cotton wool well and evenly over the surface of the paper, and allow to dry; then place the paper in contact with a bright negative in the printing frame, and expose fully to a good light. Immerse for from fifteen minutes to half an hour in a solution containing 25 gr. of Rochelle salt and 25 gr. of borax to 1 oz. of water. This gives a black image. By decreasing the borax to 9 gr. and adding three drops of hydrochloric acid, a sepia picture is obtained. Transfer for ten minutes to a 1-per cent. solution of ammonia, then wash for half an hour, and the print is finished. Ferric oxalate may be made as follows: Add to 2 oz. of ammonia iron alum, in a 20 oz. measure, 1 oz. of strongest liquor ammonia with 1 oz. of distilled water. Stir well and allow the precipitate to fall. Wash by decantation till alkalinity disappears; then add 1 oz. of crystallised oxalic acid, and make up to the desired strength with distilled water. Ferric oxalate purchased of a chemist should be tested by adding to a solution of it a few drops of a solution of potassium ferricyanide, when, if it has changed to the ferrous state, it will throw down a dense precipitate of Prussian blue.

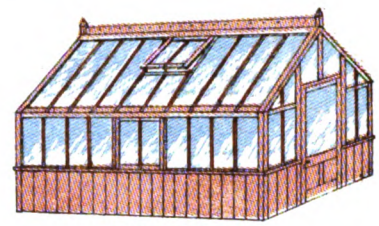
Waterproofing Canvas.—To make "chemical" canvas prepare two baths, one containing 1 lb. of yellow soap in a gallon of warm water, the other containing 1 lb. of alum in a gallon of warm water. Pass the canvas through the warm soap solution, and then through the alum solution. To obtain a very thick coat, put the canvas several times alternately through the two baths. Old canvas may be treated in the same way as new.

Advantages of Copper Range Boilers.—The lasting quality of a copper range boiler as compared with an iron one, when used to heat hard water, is not worth the extra cost. The incrusted deposit that is the usual cause of boilers becoming destroyed in hard-water districts will make the copper plate fracture nearly as soon as it will the iron. An idea is prevalent that by using a copper boiler the accumulation of deposit from hard water, and subsequent fracture of the boiler, are prevented or avoided, but this supposition is groundless: a copper boiler is at no real advantage in heating hard water. In soft-water districts copper is largely used because iron will not long withstand the active rusting process that the soft water sets up. In such places copper boilers, copper cylinders, and lead, copper, or tin-lined pipes have to be used. The thickness of the plate of copper boilers varies, for copper being such an excellent wearing material (when water is in close contact on one side of it), the plate need not be thick, and ⅛-in. plate would be ample if it were not that copper is soft and cannot withstand heavy water pressure, nor the blows that the cook delivers against the boiler front with the poker. Therefore the usual thickness is 1/16-in. body, with 1/16-in. or ⅛-in. front-plate. If the boiler is large, and the water pressure exceeds, say, 40 ft., then either a thicker body-plate must be used, or brass stay-bolts must be placed across the body-plates. Brass or copper bosses must be brazed around the pipe holes, to allow of a sound joint being made; and, in hard-water districts, it is important to remember to order a manhole large enough to insert the hand for cleaning. A 3-in. hole and a 3-in. plug are usually sent to make the manhole and lid, but this is too small. The cost varies with the market price of copper, but the boilers are usually something under 1s. per lb. Copper boilers, before they get beyond repair, should have a piece dovetailed in and soundly brazed.

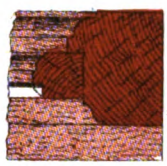
CONSERVATORIES AND GREENHOUSES.



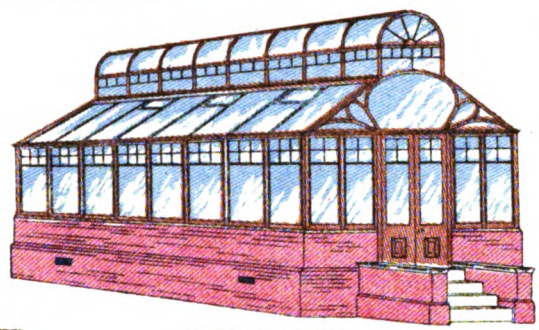
LEAN-TO GREENHOUSE



SPAN-ROOFED GREENHOUSE.

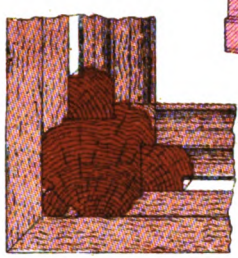


WALL POST.

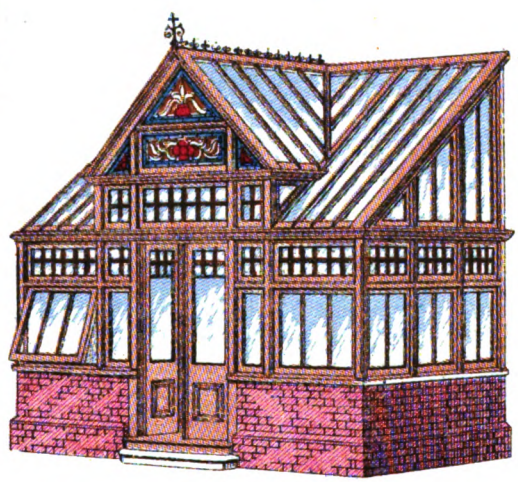


LANTERN CONSERVATORY.

HEAD.



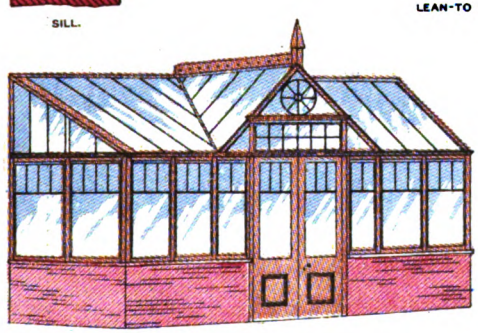
ANGLE POST.



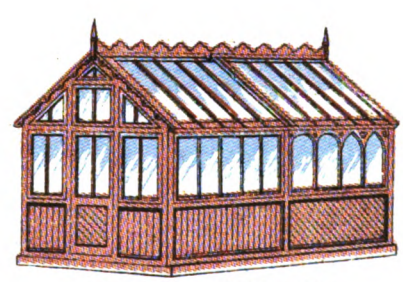
LEAN-TO CONSERVATORY.

SILL.

TRANSOM.



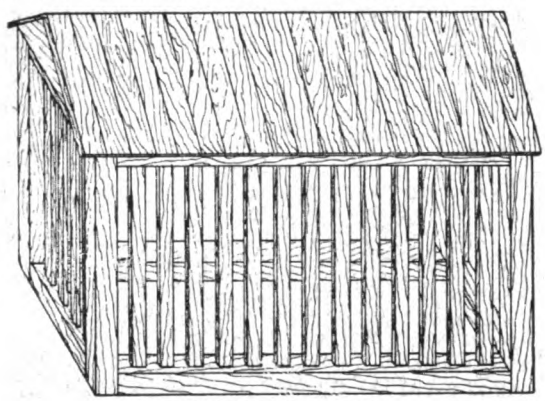
LEAN-TO CONSERVATORY.



PORTABLE SPAN-ROOFED GREENHOUSE.

Mounting Photographs.—Fill a large hand basin or dish with water, and immerse the photographs in it for a few minutes, allowing them to drain slightly after removal, and then place them with the image downwards on a sheet of glass. Lay over them a few thicknesses of blotting paper and roll out excess of moisture. Now brush over the top one with some Higgins' photo mountant or fresh starch paste, lift it carefully by the corners and lay in position, cover with fluffless blotting paper, and with a squeegee roll gently twice. If the photographs are to be mounted in an album, wet mounting may cause cockling, and in such case an alcoholic solution of gelatine should be used: Nelson's No. 1 gelatine, 1 oz.; water, 3 oz.; glycerine, 2 dr.; methylated alcohol, 10 dr. Dissolve the gelatine in the water, then add the glycerine and alcohol last. In this case the position the print is to occupy is marked on the leaf; and, the print having been dried in contact with glass, a thin coating of solution is run rapidly round the edge of the print or within the line on the leaf with a small brush and the print rolled into contact. It is always advisable for a beginner to gain skill and experience by practising on wasters or spoilt prints.

Crate for Carrying a Pig.—The accompanying drawing is almost self-explanatory. The size of the crate would depend upon the size of the pig, but about 4ft. 6in. long by 2ft. 6in. wide and 2ft. 6in. high will be large enough for any ordinary animal. The framing should be of good yellow deal



Crate for Carrying a Pig.

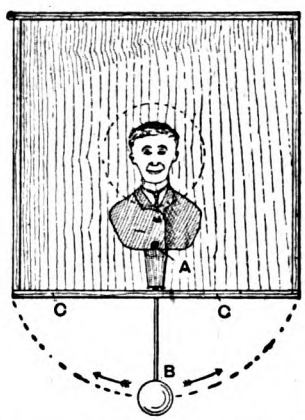
3in. square, and the laths 2½ in. by 1½ in. The latter can be either mortised into the framing as shown, or the rails can be kept back from the face and the laths nailed on. The roof should be of 1-in. tongued and grooved boarding, and the floor should be formed of 1¼-in. boards laid with spaces of about 1 in. between them. One end of the crate should be made to open to form a door for the entrance and egress of the pig. Two small iron wheels, say about 8 in. diameter, can be fixed, one at each side of the crate; a 4-in. wheel should also be mounted in the middle of each end. The crate would thus have four wheels, but would run on the two side ones only; the other wheels would prevent the crate from ploughing into the earth when the pig shifted its position.

Covering a Pulley with Leather.—A cement made as follows may be used with great success, both for covering pulleys with leather and on belt joints before riveting. The leather will tear before coming off, if carefully done. Make an extract by digesting 1 part of coarsely crushed nut-galls with 8 parts of rainwater, let stand for several hours, and filter through linen. Then pour 1 part of cold water over 1 part of best glue, let it stand for twenty-four hours, and heat to make a concentrated glue solution. To use the above, warm the nut gall extract, and coat the leather with it. Warm the pulley, which should be roughened, and coat with the glue. Lay the leather on the warm pulley, press firmly together, binding it tightly with cord.

White Coating for Model Boats.—Most makers of model boats have found that it is practically impossible to give a model a pure white surface by painting it in the ordinary way with zinc or white-lead. After standing a day or two it takes a yellow or maybe a dirty white tinge. If the following directions are carried out in a careful and cleanly way, a pure white surface which will stand the test of time and sunlight will result:—After the model has been thoroughly glasspapered down, give it one coat of paint, made by mixing ordinary white French polish with flake white powder until it has the consistency of skimmed milk. When this first coat has dried quite hard, rub it down with No. 0 glasspaper; dust the model and give it another coat of the same paint: repeat this process at least six times. Then give it another coat, but, instead of smoothing it with glasspaper, rub it down with powdered emery and water, using a piece of hair-felt. Repeat this, and a beautiful white will be the result. Do not varnish it.

Air Vessels on Pumps.—The bottle-shaped air vessels are used to produce an even, uniform discharge from the pump, the action of the pump plungers being intermittent. Air is stored inside the vessel, and the water, after having passed through the delivery valve when the vessel is on the delivery pipe, compresses the air. When the plunger makes the suction stroke, the air cushion acts as a spring and delivers the water. A suction air vessel should be used where the length of the suction pipe is great in comparison with the diameter and for high-speed pumps. The contents of the air vessels vary in different makes from three times to ten times the capacity of the pumps.

Grotesque Target for Shooting Gallery.—The illustration shows a front elevation of a novel shooting gallery target with the front removed. Make a square box, say 2ft. square and from 4in. to 6in. deep; have a circular hole about 9in. diameter in the centre of the box. Cut a grotesque head of zinc from 4in. to 6in. in diameter; extend the shoulder and neck



Grotesque Target for Shooting Gallery.

downwards a few inches, having a pivot A of wood or iron through the neck, the bearing being at each side of the box, so that the head will be in the centre of the box. Attach a piece of stout wire to the bottom of the neck piece, and, so that it swings as a pendulum in a slot in the bottom C, fasten a piece of lead B to the bottom. A bird or any animal may be made to work the same as the head.

Making Angle Zinc.—To make angle zinc to be used for constructing an aquarium, after cutting the sheet zinc to the required width, mark it deeply with the scriber or cutter along the bending line on the underside. Then place the zinc along the flat side of a beck-iron or the edge of a hatchet-stake, and, keeping the bending line upon the tool edge, press both long edges downwards, commencing at one end and working along the zinc until the opposite end is reached; then smooth down to the angle required with a mallet or dresser.

Pickle for Gun-metal Castings.—The percentage of water to sulphuric acid to be used as a pickle for gun-metal castings depends on the composition of the metal. Try by experiment. A pickle for the outer skin would be 10 of water to 1 of acid; leave in a few hours to remove sand, and finish by dipping in aquafortis and swilling quickly in plenty of water. Dry out in hot sawdust; or dip in hot water and use cold sawdust. In the trade, old dilute aquafortis is used as a pickle for castings, which are left in it overnight and dipped in strong acid afterwards.

Recharging Ink Pad of Typewriter.—A suitable ink may be made by dissolving 1 part of aniline black (soluble in oils) in 6 or 8 parts of oil of cloves by a gentle heat; while still warm, apply it to the pad with a camel-hair brush. Another ink may be prepared by grinding together very carefully 1 part of gas black and 5 parts of oil of cloves; but to make the latter properly, a grinding plant is necessary. If the pad is worn, it is useless trying to treat it.

How to Start a Dynamo.—Before starting a dynamo, examine it carefully to see that the brushes, lubricators, etc., are in order. The machine may then be run at full speed for a short time, with the brushes off, to see that the bearings are in order. It should then be stopped and the brushes adjusted to their places on the commutator. The main switch may then be closed and the dynamo set running, the speed being increased until the voltmeter or a pilot lamp shows that the correct voltage has been reached. Then, as the load comes on, the brushes may be shifted backwards or forwards, as may be necessary, for sparkless commutation.

Retouching Medium for Photographic Negatives.—The simplest retouching medium is made by dissolving about half a teaspoonful of powdered resin in 1 oz. of turpentine. Add the resin a little at a time, shaking well. It will probably take about two days to dissolve, but it should be shaken occasionally. Apply with the ball of the finger, rubbing well with a circular motion until it resists. Take the supply from the top of the cork and not direct from the bottle. Avoid streakiness or the least unevenness. Retouching medium can also be bought ready made of all dealers in photographic requisites.

"Pavodilos" Joint in Flooring.—A sketch of the "Pavodilos" rebated joint as used in floor boards prepared for secret nailing is shown by Fig. 1. It is patented, and the name is registered as a trade mark by the manufacturer of the joint. "Pavodilos" jointed flooring and matching is, however, turned out by other

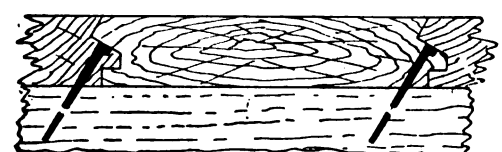


FIG. 1

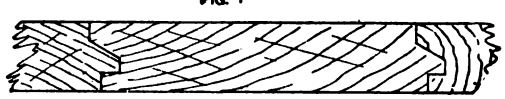


FIG. 2

"Pavodilos" Joint in Flooring.

firms who work under licence; and some specimens are worked as shown by Fig. 2, which, although the second key is lost, may possibly be preferred on account of the danger, when nailing down the flooring jointed as in Fig. 1, of damaging the feather-edge of the board that is being fixed.

Securing Dowelled Work Together.—The holes for dowels should be made exactly opposite each other in each piece forming the joint. Then the dowel should be accurately fitted in. When the work is ready for gluing up, the dowels should be glued in one part of each joint first, then the other part of the joints, dowels, etc., should be glued; the whole should then be quickly cramped up—that is, the joints forced up close. Frequently it will be found advisable to leave the cramps on until the glue has set or become hard.

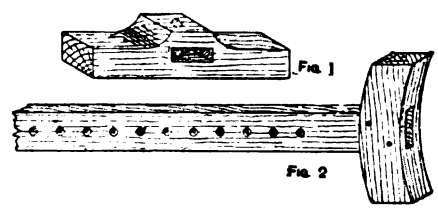
Composition of Muntz Metal.—Muntz metal consists of 57 parts of copper and 43 of zinc, or 60 of copper and 40 of zinc, or 66 of copper and 34 of zinc.

Determining Contents of Circular Tank.—A rule for finding the contents, in gallons, of circular tanks is as follows: First find the contents in cubic inches and multiply by ·0036, or in cubic feet and multiply by 6·23. The cubic capacity of a circular tank in cubic inches equals the diameter in inches squared (that is, multiplied by itself) multiplied by ·7854 and by the length in inches. For the capacity in cubic feet, take all dimensions in feet. As an example, the contents of a circular tank 4 ft. diameter by 5 ft. high equals 4 × 4 × ·7854 × 5 × 6·23 = 391 gal. (roughly).

Proportioning Rooms for Sound.—Wyborn's "Notes for Architects and Draughtsmen" gives the following rules for the proper proportions for a building in order that speaking from platform or pulpit may be distinctly heard all over the room. For concert rooms, etc., height 2, width 3, length 4 or 5. Example:—Free Trade Hall, Manchester; height 52 ft., width 78 ft., length 135 ft. For lecture rooms, etc., height 2, width 4, length 3. Example:—Theatre of Royal Institution; height 30 ft., width 60 ft., length 45 ft. The hearers should not be at a greater distance from the speaker, for convenient hearing, than 50 ft. in front, 30 ft. on each side, and 20 ft. behind. No person should be farther than 70 ft. from the speaker. The greatest number that can hear a speaker conveniently is 2,000, arranged in two tiers. The end opposite the orchestra or speaker should be semi-circular, or have the angles rounded. The ceiling should be elliptical or coved, and there should be a hollow space beneath the floor.

Concrete for Foundations.—In gauging up concrete, burnt ballast, with or without clean brick rubbish, will make fair common lime concrete, but for good concrete there should be no burnt ballast, and the brick rubbish should be clean and hard. For cement concrete, stone ballast and hard bricks, broken to pass a 2½ in. ring, would be suitable. One of lime to five of the other materials, or one of cement to seven of the other materials, is an economical proportion. Burnt ballast, like a common place-brick, crumbles on exposure to the weather, and in damp foundations will in course of time go the same way; even in dry foundations it will not bear a heavy load.

Fitting Windsor Chair as Barber's Chair.—The following is a sketch that shows how to convert a windsor chair into a barber's chair. Make two brackets, as in Fig. 1, out of elm or other hard, tough wood, and bore a hole through the centre of one, as indicated by the dotted circle. Screw the solid one to the seat of the chair at the back, and the one with the hole bored in to the back of the top piece of the chair. The plain sides of the brackets must be so fitted that when fixed the two mortises are in a straight line with each other. Now fit a piece of wood about 3 ft. long into the



Fitting Windsor Chair as Barber's Chair.

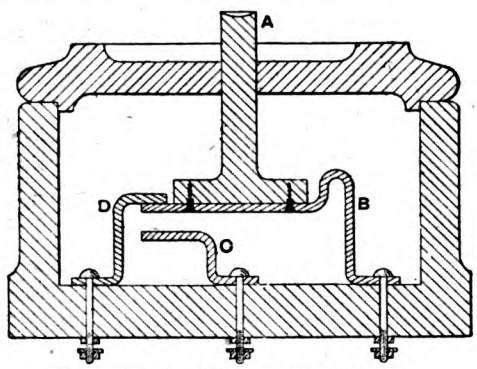
mortises in the brackets, so that it will slide easily up and down. Fix a cross-piece to the top of this, as shown in Fig. 2, and also bore holes up the middle at intervals of 1½ in. To fix the sliding piece at the height required, an iron pin is used; this should be connected with the top bracket by a short length of chain. The cross-piece should be covered and padded.

Jonval Turbine.—This works by pressure, and may be drowned or connected to a suction tube. It is an axial or parallel-flow turbine, the water passing through the motor in directions parallel with the central shaft. The water enters a fixed wheel, and is guided into the movable wheel keyed to the shaft, which rotates on a pivot bearing. To regulate the power of the turbine, a number of the guide passages are closed by a special casting, carrying a segmental rack worked by a worm. The efficiency of the Jonval turbine increases with the load.

Working Celluloid.—To work thin sheet transparent celluloid into different shapes, it is pressed with heat in a hydraulic or other press or mould, and allowed to cool gradually. A French recipe for non-inflammable celluloid consists in dissolving ordinary celluloid in acetone in about the proportion of 25 grammes of celluloid to 250 grammes of acetone, and dissolving pulverised magnesium chloride in alcohol in the proportion of 150 grammes of alcohol to 50 grammes of magesium chloride. Then mix the two solutions so as to obtain finally a pasty mass, containing, say, 20 grammes of the magnesium chloride for each 100 grammes of the celluloid. An uninflammable material, similar to celluloid, was invented in 1898 by Cadoret, of Paris, which he claims to be a substitute for indiarubber, celluloid, leather, oilcloth, linoleum, mother-of-pearl, tortoise-shell, amber, ivory, etc., and which is capable of being moulded, drawn, or made into threads, and in the form of plates, tubes, and cylinders, or soft and silky threads resembling silk in appearance, and can be dyed in various colours. It has another peculiarity—that while the dies or rolls are cold, there is no polish on the surface of the rolled sheet or moulded article, but with heat and pressure the polish of the mould is given to the pressed article. This material, to which the name of "textiloid" has been given, can be made as transparent as glass.

Diminished Twisted Column.—In setting out and working a diminished twisted column for masonry, first set out the column to the extreme diameter of outside of wreath or roll, with the diminish and entasis as in an ordinary column. Having decided how many times the wreath is to encircle the column, set out the spiral to a developed line. If a piece of paper is cut the shape of a right-angled triangle, the height of the perpendicular being equal to the height of the cylinder, the hypothenuse (or long side of the triangle) will generate a curve winding round the cylinder in the form of a spiral. This curve is called the helix, and is the developed line of centre of wreath or roll required. In order to illustrate this more clearly, take two long ribbons of paper cut parallel, one piece being white and the other piece black; wind first, say, the white round the cylinder, leaving a parallel space just sufficient for the black piece, which now wind round the vacant space, touching perfectly each of the edges of the white band. This being done, let the white band represent the roll and the black band the hollow, or vice versâ. This example applies to a cylindrical shaft whose ends form equal parallel circles. In the case of the tapering column the developing of the spiral line will require great nicety in the setting out; and although the band will not be quite parallel, the principle is the same. The shaft is first worked as a plain column to the extreme or outer diameter. The spiral line is then traced round the shaft, and the hollow worked out. Lastly the roll is rounded off, each process being guided by reverses or templates.

Construction of Double-contact Electric Push.—The essential parts are shown in the adjoining illustration. A push A is connected to a spring B. Under-



Construction of Double-contact Push.

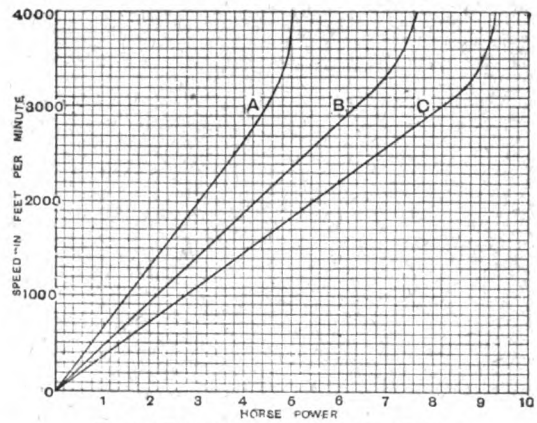
neath the push is a smaller spring contact C, and at the side opposite B is another contact D. B, C, and D each have terminals, not necessarily in the form sketched. By these terminals the connections required may be made. In the standing position B and D make contact, but by pressing A the circuit is made by way of B and C.

Separating Lead from Zinc.—The mixture can be raised above a red heat, when the zinc will burn away; or it can be granulated, and then placed in acid to dissolve the zinc. Or stir into the molten mixture a quantity of ground sulphur, which will combine with the zinc and rise to the surface, and form a crust or cake, which can be taken off.

Taking Apart and Cleaning English Lever Watch.—Before attempting to clean a watch, it is advisable to become thoroughly acquainted with its mechanism. First remove the hands and dial, then unscrew the balance cock and take out the balance, unpinning the hairspring if necessary, and notice how far through the stud it comes, so that it may be properly replaced when putting together again. Then let down the mainspring by lowering the click screw under the pillar plate and putting a key on the square of the barrel arbor. Take out the barrel and bar, also the pillar pins, raise the plate gently, and with a pair of tweezers remove the lever; then take off the top plate and remove all wheels, etc. Place all the parts, except the barrel and fusee, in benzine. Take out and brush clean with a soft watch brush and a trace of dry chalk. Brush clean the fusee, take off the barrel cover, and oil the mainspring. With a watch peg sharpened to a fine point, clean out the pivot holes. To put together, place all wheels in position on the pillar plate, but not the lever; put on the top plate, and then introduce the lever between the plates and get it into position; then get the top plate down properly and insert the pillar pins. Put in the barrel and bar, put on the chain by dropping it through the watch in position, and hook the barrel hook in the barrel. With a key on the barrel arbor, wind it all upon the barrel and place the fusee hook in the fusee. Then set up the mainspring half a turn, and wind the chain up on the fusee, being very careful to see that it goes straight. Oil the pivots in the top plate and the balance pivot holes. Put in the balance and repin the hairspring, being careful to get it in beat. To test this, wedge the fourth wheel with tissue paper, and when the balance is at rest the ruby pin should be in the lever notch and the lever should stand midway between the banking pins. See that the hairspring lies flat and beats evenly between the curb pins in the regulator; also see that it does not touch the balance arms or the plate. See that the balance has a little "endshake" in its pivot holes. Oil the bottom pivot holes, and put a little oil on the points of the 'scape-wheel teeth. Do not oil the other wheel teeth or the ruby pin. Use only the best watch oil.

Girard Turbine.—This is a parallel-flow impulse motor, the power being due almost entirely to the velocity of the water. The guide blades, in the vertical form of motor, may be closed by special vertical shutters worked by special gear, and the passages through the wheel are widened towards the outlet of the water. The efficiency of the Girard turbine may be highest on low powers. A suction tube cannot be used, as the wheel must be close to the level of the tail race.

Power Transmitted by Leather Belts.—In the diagram given below, the curve **A** refers to single belts, best oak tanned, curve B to similar light double



Power Transmitted by Leather Belts.

belts, and the remaining curve C to heavy double belts. Each curve shows the horse-power that may be transmitted by a belt for each inch in width. Thus a single belt 1 in. wide will transmit about 3 horse-power when running at a speed of 2,000 ft. per minute. Similarly, at that speed, a light double belt will transmit rather more than 4·2 horse-power per inch of width, while a heavy double belt would transmit about 5·4 horse-power. It will be noticed that the lines curve upward at the higher speeds, the decreased power thus shown being accounted for by the centrifugal force set up. To keep the belt central with the face of the pulley, the latter should be slightly rounded, say $\frac{3}{8}$ in. or $\frac{1}{2}$ in. per foot.

Making Sheraton Easy Chair.—The frames of these chairs are made of deal, and the legs of hard wood such as birch. The inside only of the chair is upholstered, the outside being covered with the same material as secured to the frame. The following dimensions are suitable:—Total height of back, 4 ft.; width of seat from front to back, 2 ft.; width of seat, 2 ft.; height of legs from floor to bottom of seat frame, 10 in. without castors; height of arms from seat frame, 1 ft. The back legs should be $1\frac{1}{2}$ in. square; these can be bought ready sawn, with the required sweep of 2 in. at the bottom. The front legs are made from 2 in. square stuff. The seat frame should be 2 in. by $1\frac{1}{2}$ in., raised with a stuffing-rail 2 in. high. The back will have three cross-rails 2 in. by $\frac{1}{4}$ in., stump-tenoned into the back legs. Web the insides of the back and arms, and cover with hessian as a foundation for stuffing. Stuff all the inside with hessian before putting on the outside covering, which is usually a cotton imitation tapestry. The edges can be corded or finished with brass or copper nails.

Sizes of Whitworth Nuts and Bolt-heads.—The following table gives the thickness of the bolt-heads and the widths of hexagon nuts in the Whitworth standard. The third, fifth, and seventh columns are to the nearest sixty-fourth of an inch:—

Diameter of Bolt and Thickness of Nut in In.	*Thickness of Head in In.*		*Width of Nut across Flats in In.*		*Width of Nut across Corners in In.*	
¼	·4375	7/16	·9191	15/16	1·06	1 1/16
5/16	·4921	1/2	1·011	1 1/32	1·16	1 3/16
3/8	·5468	9/16	1·101	1 1/8	1·27	1 5/16
7/16	·6015	5/8	1·2011	1 7/32	1·38	1 7/16
½	·6562	11/16	1·3012	1 3/8	1·5	1 9/16
9/16	·7109	11/16	1·39	1 7/16	1·6	1 5/8
5/8	·7656	3/4	1·4788	1 1/2	1·7	1 3/4
11/16	·8203	13/16	1·5745	1 5/8	1·82	1 7/8
1	·875	7/8	1·6701	1 11/16	1·95	1 31/32
1 1/16	·9843	1	1·8605	1 7/8	2·15	2 3/16
1 1/8	1·0937	1 1/16	2·0483	2 1/16	2·36	2 3/8
1 3/16	1·2031	1 1/8	2·2146	2 1/4	2·55	2 9/16
1 1/4	1·3125	1 1/4	2·4134	2 7/16	2·78	2 13/16
1 5/16	1·421	1 5/16	2·5763	2 5/8	2·97	2 31/32
1 3/8	1·5312	1 7/16	2·7578	2 13/16	3·18	3 3/16
1 7/16	1·6406	1 1/2	3·0183	3 1/16	3·48	3 1/2
2	1·75	1 3/4	3·1492	3 3/16	3·63	3 5/8

The odd 1/16-in. sizes given above are seldom used.

Inexpensive Filter for Oil.—To make a cheap filter for light machine oil, obtain a large ribbed glass funnel about 6 in. diameter; take a clean sheet of thick

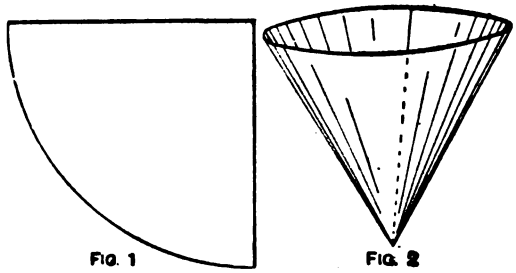


Fig. 1 Fig. 2

Inexpensive Oil Filter.

white blotting paper, and cut from it a circle 10 in. diameter, then fold the paper twice to the shape shown in Fig. 1, and open it out like Fig. 2, so that it fits the funnel. Now place the paper in the funnel and the latter into a clean can, and pour the oil into the paper, taking care that it does not flow over. The oil will filter through slowly, and will be perfectly clear and bright. When the paper becomes clogged, it must be replaced by a new piece.

Brazing Bandsaws.—Ordinary bandsaws may be brazed as follows:—Taper the ends of the saw by filing so as to form two wedge-shaped ends for about the length of three teeth. Lap the ends, and place a small quantity of the flux on them; cut off a narrow piece of the brazing metal (about 1 in. by ¼ in. will do for an inch saw), place it between the ends of the saw, and cover the joint with flux. The saw, being clamped and held in position in a suitable holder, is now ready for brazing. Heat to a bright red heat a pair of heavy tongs, free from scale between the jaws, and hold them tightly on the saw until the brazing metal melts; then slip off the heavy tongs, and grip the braze with a lighter pair that has been made black hot. When the joint is well set, remove the tongs and file the braze to uniform thickness. The saw is ready for use when the teeth where the joint is made have been sharpened and set. For brazing heavy bandsaws, a small machine may be used, by which the saws are kept in position over the fire by means of a hinged clamp having set-screws on each side of the joint. The brazing is done with two pairs of tongs. Brass spelter and borax as a flux makes very strong joints in bandsaws of ordinary widths. Equal parts of copper and coin-silver, melted well together, rolled out thin and cut in strips, is said to make good brazing metal. One ounce is sufficient to make over thirty joints, in bandsaws 1 in. wide. Two ounces of flux will be sufficient for 1 oz. of brazing metal.

Strength of Springs for Vehicles.—The following list has been furnished by a leading axle maker:—

Mail and Collinge axles suitable for a vehicle bearing the load shown:—

Size	1	1¼	1½	1¾	1¼	1¼	1¾	1¾	2 in. diameter.
Weight	5	7	10	12	15	18	22	26	30 cwt.

Drabble and cart arms suitable for a vehicle bearing the load shown:—

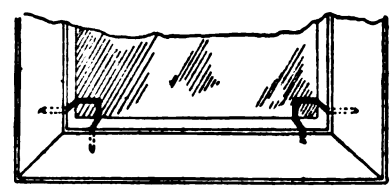
Size	1¼	1¾	2	2¼	2½	2¾	3 in. diameter.
Weight	10	15	20	25	30	45	55 cwt.

Springs.—A comprehensive list cannot be given, as there are so many variations in size; the quality of steel also has a great influence. The following are a few customary sizes of trap and cart springs, with the weights they are supposed to be suitable for:—

Size of Spring.	*Load Borne by Vehicle.*
44 in. × 1¼ in. × 5 in.	6 cwt.
46 in. × 1½ in. × 5 in.	8 cwt.
48 in. × 2 in. × 5 in.	10 cwt.
48 in. × 2 in. × 6 in.	12 cwt.
48 in. × 2 in. × 7 in.	14 cwt.
48 in. × 2½ in. × 7 in.	17 cwt.
48 in. × 2½ in. × 8 in.	20 cwt.

Ordinary merchant quality springs are made of steel of unguaranteed temper, hence the temper is variable, often resulting in weak, unsatisfactory springs. Buyers of springs should require a guarantee that they are made of guaranteed material with a temper, for heavy cart and waggon work, of not less than 0·40 per cent. of carbon; for light trap and carriage work not less than 0·45 per cent.

Wire Rests in Wet-plate Photography.—In wet-plate photography, the silver wires on which the plate



Wire Rests in Wet-plate Photography.

rests are fixed in the carrier, as shown in the accompanying illustration. This special device is used because the drippings from the wet plate exercise a destructive influence on the woodwork of the slide, but an ordinary slide may be used if blotting paper is placed along the bottom to absorb the drippings; or the slide may be coated with shellac, asphaltum, or paraffin wax.

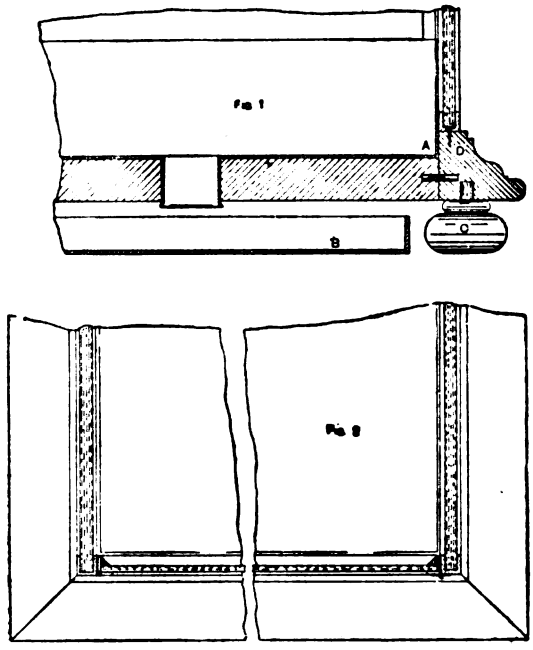
Lead of Slide Valve of Steam Engine.—The lead of a slide valve is the amount by which the steam port is open when the piston is just going to commence its stroke. The supply of steam to the cylinder then commences before the stroke, and the moving piston is brought to rest against a cushion of steam. The amount of lead varies from 1/32 in. to 1/8 in., according to the type of engine.

Damp-proof Stiffening Solutions.—For stiffening materials that will be exposed to damp, a solution similar to that used for stiffening hats is suitable. This is composed of 5 parts shellac and 1 part borax, with sufficient water. A useful water-proofing material may be made by dissolving shellac in ammonia. A good stiffening waterproofing material is boiled linseed oil, which stiffens by exposure to air and is very pliable. Another waterproofing substance may be applied by passing the materials through a soap bath and afterwards through alum solution; this produces an alumina soap in the fibres and stiffens the fabrics.

Polishing Ebony Walking-stick.—To polish an ebony walking-stick a jet black, mix Frankfort black or black aniline spirit dye with the polish; the latter may be made by dissolving 6 oz. of garnet shellac in 1 pt. of methylated spirit. Apply with a camel-hair brush. Best results are gained if polishing pads made of wadding enclosed in fine rag are used.

Ink for Rubber Stamps.—To make a good rubber stamp ink, pulverise 180 gr. of aniline violet and dissolve in 2 oz. of boiling distilled water; add one teaspoonful of glycerine and half a teaspoonful of treacle.

Fern Case Construction.—Fig. 1 shows a section through a part of a case for rearing ferns. The bottom is of deal, with a polished mahogany edging or rim which forms a base, the bottom being tongued to it on each side and fixed. The bottom stands ½ in. below the rim, to receive the tray A. The latter is 2½ in. deep, with a hole in the centre to convey superfluous moisture to the zinc safe B underneath, and is covered with a thin layer of broken brick, or other similar material, and with 2 in. of mould, in which the ferns are planted. The safe slides between the feet C, on which the case rests. The zinc tray should be first fitted into the bottom and secured with screws, the heads soldered over, the channel edging D bent to fit the domical glass at each end, and also mitred at the angles to fit the rails on the base, composed of the same section material. Well solder the angles together, then put screws along the inside of the channel into the base, as shown, and run a little fine solder along the edge to fix it to the tray. Then put the glass into position by slightly extending the framework at the ends, and bring the frame tight to it. Take a

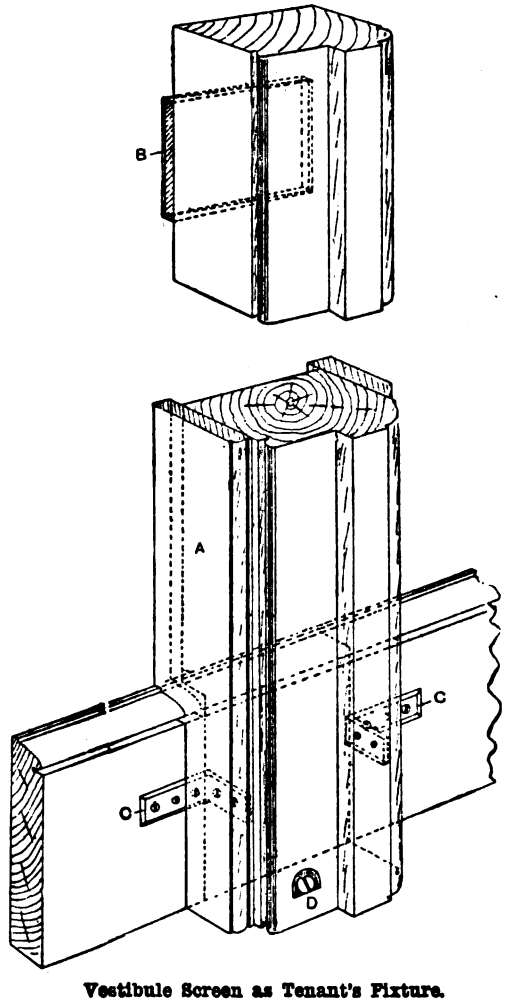


Constructing a Fern Case.

piece of bell tube the same length as the out to out of frame and solder at each end, keeping the joint in the tube at the top. A piece of ornamental cre-ting, slipped into this joint and soldered to the tube, will give a good finish to the case. Make the doors at each end out of angle pieces to fit the frame as shown, and hinge on the side. The glass in these doors must be left short from the top for the admission of air, otherwise the plants will be stifled.

Steam Consumption in Engines.—The most economical steam consumptions in simple, compound, and triple engines per indicated horse-power hour have been found on trials. A simple Corliss engine has used 17½ lb., and a simple Schmidt engine, with superheated steam, 17½ lb. Of compound engines, several American, French, and German engines have used more than 12 lb. and less than 14 lb., while a triple-expansion Willans engine may use 12¾ lb., and a similar Sulzer engine less than 12 lb.

Removable Vestibule Screen.—The sketch shows how a frame may be fixed, without injury to the premises, as a tenant's fixture, removable at the expiration of the lease. No plugs are allowed to be put into walls, and where fixing is required it must be done by means of screws—nails are not permissible. Take the exact width between walls, and allow 1½ in. narrower in the outside width of the frame. The skirting projects, say, ¾ in. on each side; the frame must be scribed over this equally on each side, as shown. Get four brass angle-plates C, chamfered on face for preference; let one side into the edge of the frame in each case, the other screw on to the face of the skirting. This will securely fix the lower part; an additional fixing is obtained by screw D into floor. The upper part must be secured by means of folding wedges B, 4 in. wide, between the frame and plaster. These should be driven tightly home, and should be placed as nearly as possible over the jamb at the top and at the level of the transom at the side. When the frame is firm, drive some fine brads through the edge of the frame into the wedges, to keep them from



Vestibule Screen as Tenant's Fixture.

moving if the frame is jarred by the banging of the door at any time. The fillets A shown on the edge may now be fixed; they must be scribed over the skirting and to the plaster, and fixed to the frame with panel pins. These fillets completely hide all fixing with the exception of the end of the brass bracket on the skirting, and this is not unsightly. The job, if carried out properly, will be a good one, and the screen, while equal in stability and appearance to a permanent fixture, can be quickly and easily removed.

Resin used in Spirit Varnish.—Shellac dissolved in spirit forms the basis of most spirit varnishes; the addition of resin is often advised on the score of cheapness. It also assists the varnish to flow level, gives it more body, and imparts a brightness not obtainable by the use of shellac alone. As excess of resin yields a varnish easily scratched, benzoin is added to make it harder, in addition to increasing its brilliancy. Shellac and spirit alone will suit for some purposes as a varnish, but will generally need more shellac in than when for use as French polish to be applied by means of pads.

Renovating Patent Leather Shoes—To renovate the enamel of patent leather shoes, tree them up tight, and with a sharp knife skive off all the ragged parts of the enamel. Now rub over the whole with very fine sand-paper. This will make the shoes look dull, but they can be revived with leather varnish, patent varnish, ordinary black cream, Nubian, ebonite, or even a thin coat of black polish as used by French polishers.

Putting Spring Seat to Cushion-seat Couch.—To convert a cushion-seat couch into a spring-seat couch, take off the couch back; this will be nailed to the body along the bottom and into the head. If the bottom is boarded, remove the boards, and put a stuffing rail on the front 2in. high; this will leave a rebate for tacking, banding, etc. If a very soft seat is desired, cross-web the bottom with best spring webbing. If spring rails are required, let five in at equal distances apart in the front and back rails. Ten 8-in. spiral springs will be wanted; secure two to each spring rail with wire staples, or, if a webbed bottom, tie fast with strong twine through the web. Cover the bottom over the springs with course canvas, tack on the front side securely, and pull down the other till the springs are compressed about a quarter their length; then tack the other side. Put your arm under the ends, and place the springs in an upright position, then stitch fast to the cover with needle and twine. Put on a layer of flocks about 2in. thick, cover the top with another piece of canvas, and tack fast all round; stitch up the front edge to a fine point with four rows of stitches. The couch will now be ready for outside covering.

Turning a Crank-shaft.—The adjoining sketches show one method of turning the crank-pin of a small crank-shaft of an engine, Fig. 1 being a front elevation and Fig. 2 a side view. Iron slabs, lettered A, are fastened, one at each turned end of the shaft B, by set-screws C. The slab is centred at E, so that D in Figs. 1 and 2 represents the throw of the crank. Sometimes the hole in the slab is larger than the turned end of the shaft; the hole is then packed so that the distance D between the centres can be adjusted. To stiffen the system, long bolts at F are introduced, being jambed tight by nuts at the ends. The slabs are often to the shapes shown by the dotted lines in Fig. 2. The centres of the slabs and of the crank-pin must be in line, the positions being set by the aid of vee-blocks, plumb-bob, and scribing block.

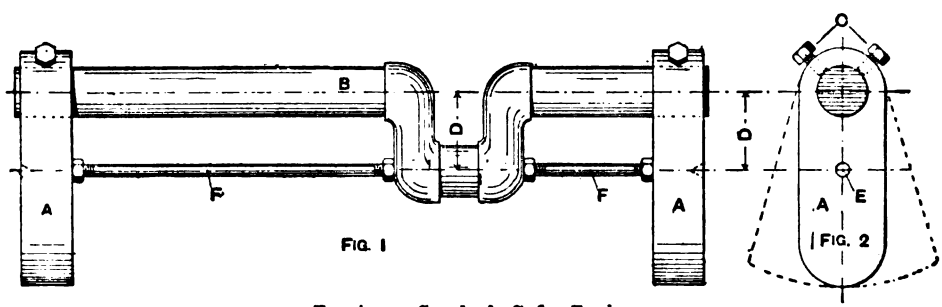


FIG. 1 FIG. 2

Turning a Crank-shaft for Engine.

Proportions of Square Nuts and Bolts.—The following are the usual proportions of square nuts and bolt-heads:—The width across the flats of black nuts may be one and a half times the diameter of the bolt, plus from ·18 in. to ·44 in.; or of bright nuts, one and a half times the diameter, plus from ·06 in. to ·18 in. Across the angles, rough nuts may measure 2·12 times the diameter, plus from ·25 in. to ·6 in.; and bright nuts, 2·12 times the diameter, plus from ·08 in. to ·25 in. The height of the bolt-head may be from two-thirds of the diameter of the bolt to equal to this diameter.

Dull Black Finish for Furniture.—To make a black stain that will give a dull finish, as seen on Chippendale furniture, it is usual first to stain the wood with extract of logwood and copperas, followed by solutions of acetate or sulphate of iron. This, in turn, is French-polished, an intense black being obtained by adding black aniline spirit dye to the polish. When perfectly hard, this is dulled by well brushing with finest-grade emery or pumice powder. Staining alone is rarely sufficient for any but the very cheapest class of work. The following is the French method of obtaining a dull finish on high-class goods: The articles are first coated with camphor water, and almost immediately afterwards with a coat of sulphate of iron and nutgalls. When quite dry, the surface is rubbed with a very hard brush of couch-grass, and then with the lightest and finest-quality charcoal, the flat portions with stick or cake charcoal, the carved or incised portions with powder, using linseed and turpentine to keep the surface cool and moist. This process yields best results when employed on woods of a hard, close grain.

How to Make Collodion.—Take 1 oz. of pyroxylin or collodion cotton, 36 oz. of ether, and 12 oz. of alcohol of 90 per cent. strength; place in a dry, stoppered bottle, and shake from time to time till dissolved. The best liquid for diluting the collodion is a mixture of ether and alcohol in the above proportions.

Drying a Mop.—As a means of twisting a mop for the purposes of drying, other than by the ordinary method of using one hand and a wrist, a hole is sometimes bored through the handle about 15 in. from the upper end, and through this is rove a short line, say 30 in., a knot tied close to the hole on either side keeping the line in place. By starting the mop twisting in a vertical position and pulling both ends of the line and releasing them together, the mop is rotated quickly in alternate directions.

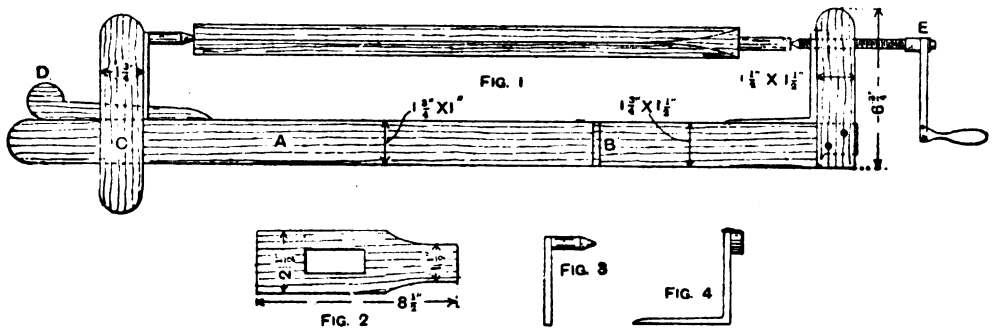
Red Filling for Letters on Engraved Door-plate.—When filling an engraved door-plate with wax, the utmost cleanliness must be observed, as any foreign matter rises to the surface, and the wax should be rubbed down till a clean and brilliant colour is established. The best vermilion wax should be obtained, and it should then be powdered. To do this, break the wax into convenient pieces, and place between two clean pieces of brass or iron plate; wrap the whole in several thicknesses of brown paper, tie with twine, and hammer the package well. This will make the wax quite small enough. Another plan of filling the lines is to heat the plate, and rub in the wax from the slab or stick; another is to grind up the powdered wax with gold size, set in with a palette knife, and put aside to harden. Clean off with alcohol. Or dissolve wax in pure alcohol to a creamy mixture, so that it will pour freely and fill the letters; leave to set hard, then clean up with spirit.

Hardness of Water.—The hardness of water depends to a very large extent upon the nature of the rock through which it percolates, and the extent to which it penetrates. Deep well water obtained from a shaft sunk to a great depth into water-bearing strata is usually more or less hard. Water issuing from springs may be either soft or hard; from granite and the older rocks the water is soft, because it penetrates but little; but in the newer formations, especially magnesian limestone, oolite, lias, chalk, etc., the spring waters are very hard. Water from the surface flowing over pure clay or gravel will be, as a rule, soft, because there is little soluble matter contained therein; but from a shell gravel the water will be hard. Water collected in shallow wells is often very hard, the water percolating readily through the soil and subsoil, and dissolving out the salts contained therein. The salts not precipitated by boiling are removed every time the kettle is emptied; the scale will contain principally the carbonates. In a boiler the case is different, as the concentration of the water by evaporation causes the precipitation of both carbonates and sulphates; but an analysis of the water is better, because there may be present chlorides of calcium and magnesium, which also render the water hard, and may cause trouble in other ways. These salts are extremely soluble in water, and would not precipitate however long the water was boiled. The deposit inside a kettle would be white if only lime and magnesia were present; but if iron were also present, the deposit would be yellowish or cream-coloured.

Soldering a Silver Watch Case. — Ordinary easy running silver solder, which melts at a lower heat than silver, will do. But to make sure, shred the solder into very thin strips, and apply plenty of borax to them as well as to the joint to be united. Use the blowpipe gently at first so as to bake the borax, then heat the case all over almost to the melting point of solder, and direct the flame to the part to be soldered until the solder runs and glistens. Cease blowing instantly, and plunge the case into a solution of sulphuric acid 1 part and water 10 parts, to whiten it; then wash in hot water and dry in sawdust. Be careful to remove all steel springs before soldering a case.

Size of Corliss Valves for Steam Engines.—The diameter of Corliss valves used for the admission of steam to engine cylinders when the diameters of the cylinders are known may equal one-eighth the diameter of the steam cylinder plus 2 in., while the diameter of similar exhaust valves may equal one-sixth the diameter of the cylinder plus 2 in. Thus, for a cylinder 24 in. diameter, the steam valve should be $\frac{24}{8} + 2 = 5$ in. diameter, and the exhaust valve $\frac{24}{6} + 2 = 6$ in. diameter.

Dressing Up Spokes of Carriage Wheels. — An easily made apparatus that will hold the spokes of wheels whilst dressing them up is illustrated by Fig. 1, which is a side view showing a spoke in position. The bottom rail A is 1¼ in. deep by 1½ in. thick, shouldered in at B to 1 in. thick. On this part the block C works along by the mortise shown in Fig. 2, being kept in position by the wedge at the back D (Fig. 1). To this block is fixed an iron plate (see Fig. 3),



Apparatus for Holding Spokes of Wheels.

the lower part being 1½ in. wide by ¼ in. thick, the projecting centre-point being ¼ in. round, welded into it. A pillar 1½ in. square is mortised on the front end, being firmly fixed by a corner plate, as Fig. 4. This is made with a boss at the top to the full width of plate, 1½ in., through which the ¼-in. screw E is fitted. This has a handle fitted at the end, and when in use the frame is held in the vice, or may be cramped to the bench, and the block is slid along to about the length of the spoke. The latter is placed between the two centre-points, a turn or two of the screw holding the spoke firm, whilst it can also be turned round in any position for working.

Cleaning and Relacquering Brass.—To clean and relacquer brass fittings, take all the parts to pieces and place them in a boiling solution of carbonate of soda or potash, 1 lb. to a gallon of water. To remove the old lacquer, swill in clean water. Then dip in commercial aquafortis quickly several times till of a golden colour, swill each time in clean water, and add a pinch of cream of tartar to the last swilling. Dry out in hot sawdust. Burnish the bright parts with a steel burnisher, using a little oxgall to lubricate. Dry out in sawdust as before. Heat on a hot plate, and lacquer with a camel-hair brush.

Tinning Sheet Copper.—If to be tinned on one side only, first smear with salt and water the opposite side; then, with a pad of tow, wash the other side with killed spirits (chloride of zinc), and also sprinkle a little powdered sal-ammoniac over the surface. Place the sheet over the fire, and when hot enough, rub the end of a strip of tin on it until a small portion of the tin melts; then, with a pad of tow or wadding, on which some powdered sal-ammoniac has been sprinkled, rub the molten tin over the hot surface, and continue this operation until the whole surface is covered. If the copper is to be tinned on both sides, an iron bath of semi-circular section, built up over a firegrate, should be used. Having melted a sufficient quantity of tin in the bath, pass the copper sheet through it, and as it is withdrawn, quickly wipe the superfluous tin from each side with a pad of tow. The surface of the copper should be first prepared as described above.

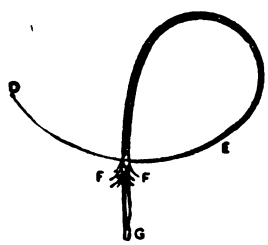
Green Stain for Wood.—A clear dark green stain may be made by mixing aniline dyes as sold at most druggists' with plenty of hot vinegar. Green and blue yield a useful tone. Or apply hot 2 oz. of verdigris, ½ oz. of China blue, and 1 pt. of vinegar; several coats will be required. These water stains have a tendency to raise the grain. The subsequent rubbing down with glasspaper will give the white flecks often seen on frames. If this is objected to, colour must be used in the polish or varnish. Another simple plan is to use emerald and bronze green mixed in hot beer.

Making Photographic Prints by Gas and Dull Light.—Any gelatino-chloride paper may be slightly printed and afterwards developed. The great drawback to the process is the liability of obtaining degraded high lights with a consequent flattening and fogging of the image; because if the faint image from a brief exposure under a negative can be developed into a dark print, any chance exposure of the paper to daylight will show by fog and degradation. If the paper has been properly protected from extraneous light and is otherwise suitable, development has a tendency to intensify the contrasts, therefore a little fog is sometimes an advantage unless allowance has been made in the negative. Eastmans', Paget, and Otto gelatino-chloride paper can be recommended for this process. Print a faint image in diffused light—that is, expose for about five minutes to daylight or one hour at 6 in. from an incandescent gaslight. Make up the following solutions:—No. 1. Hydroquinone 25 gr., metol 10 gr., sulphite of soda 25 gr., potassium bromide 50 gr., ammonium bromide 100 gr., water 8 oz. No. 2. Sodium hydrate 15 gr., water 2 oz. No. 3. Tannic acid 8 gr., water 1 oz. Take thirty-two parts of No. 1, eight parts of No. 2, and one part of No. 3. Immerse the print without washing. It rapidly bleaches to a light yellow, then slowly increases in density. When nearly dark enough, remove the print and place it in a 1 in 60 solution of acetic acid, and thoroughly wash for ten minutes. Great care must be taken to wash out all the acid, or uneven tones will result. The print may then be toned in the ordinary sulpho-cyanide bath and fixed as usual. Avoid handling the paper or stains will result. Another method by which prints of a fairly satisfactory colour may be obtained without toning consists of pouring over the dry print a solution of pyro 1 gr., bichromate of potash solution (1 gr. in 2 oz.) 10 minims, water 1 oz.; a print of a sepia tone results. But it is difficult to avoid degraded high lights; it is, in fact, practically impossible if a larger proportion of bichromate solution than that given above is used. An acid fixing bath has been recommended.

Cleaning Buff Leather Gaiters.—To clean gaiters made of sun tanned sheepskin, with the flesh side outside, wash them thoroughly and scrub out all the dirt. When quite dry, scrape them all over very lightly, paying special attention to the parts that were dirtiest, with a dull knife, a buff knife, or the edge of a blunt shoemaker's knife; if the knife is too sharp the leather will be worn away. When the gaiters are rough all over, apply some Propert's brown ball, or a mixture of brown ochre and chalk mixed to the shade required, and rub in well with fine sandpaper, then with a piece of old cloth. If the gaiters are then brushed out lightly with a soft brush, they will have the appearance of new goods.

Secret or Invisible Inks. — The usual invisible or sympathetic inks are made from cobalt nitrate or chloride, which in the hydrated condition (that is, containing water) are a pale pink, but become deep green by loss of water on heating. Writing upon paper with these inks is invisible at the ordinary temperature, but by warming the paper the marks appear very distinct, but fade away again after a short time. In hot climates the writing would not be invisible. Invisible writing may be done with a solution of tannic acid, and developed at any time by soaking in a dilute solution of ferric chloride. A true ink is then formed. Another method is to write with a solution of boiled starch, and develop the writing by damping the paper and holding it for a few minutes over a bottle containing iodine; the blue iodide of starch is then formed, and the writing becomes quite distinct for a time. It fades away again as the paper dries, but may be developed in the same manner several times. Another process is to write with a solution of lead acetate, and develop by moistening the paper and holding it over a bottle containing sulphuretted hydrogen; the writing then becomes permanently black, sulphide of lead being formed.

How to Put a Bristle on a Waxed Thread.—To put a bristle on a waxed thread, as used in shoemaking, D shows the bristle split, and the end of the taper of the thread in the crutch of it at E. Hold this point between the thumb and finger of the left hand, so that it does not pull out at the bottom F while the two are being twisted together with the thumb and finger of the right hand. When twisted, still hold them firmly at E, and put the bottom



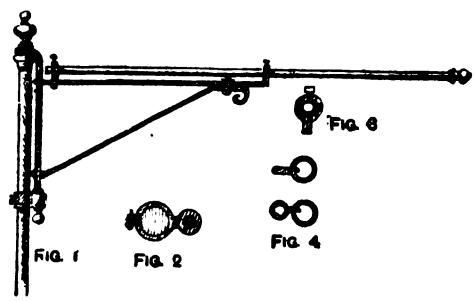
How to Put a Bristle on a Waxed Thread.

F between the little finger and the next finger. With the right hand twist the other portion of the bristle—that is, the top F. Then put the two F's together, hold them with the right hand and let go with the left, and D and E will twist of their own accord. Then fasten the ends at F so that they cannot untwist, as in the adjoining sketch. Take G as the thread or waxed end, and through this make a hole between F F and E, but very near to F F; then take D and pass it through this hole. By pulling D, E will also pass through the hole—in fact, all the bristle except the two ends F F; that portion of the thread will also pass through that has been twisted in with the bristle.

Sticking Artists' Canvas to Millboard. — Having rubbed the back of the canvas with coarse glass-paper, coat the material with some strong glue, rub d wn thoroughly, and press until dry. Failure often occurs through not properly removing the air from between the pi ture and the millboard. The correct method is to place a square of thick paper over the face o the painting and then expel the air by rubbing, with closed fist, over the whole surface, commencing from the middle and rubbing towards the outside edges. If air gathers under the middle, and it cannot be forced out round the edges on account of the glue having set, prick the blister with a fine needle, and, having let the air escape, rub down well and put a weight on the spot for an hour or two.

Photographic Lens for Portraits and Enlarging. —Any lens may be used for enlarging quarter-plate pictures to about 12 in. by 10 in. Theoretically, the best lens to use for the purpose is the one that has been employed to take the picture. Practically, the best lens is a portrait or rectilinear lens having a flat field and a large aperture. The focus should not be long, or the camera will require great extension. If a 6-in. focus portrait lens is used, the camera must be extended 24 in. and the lens be placed 8 in. from the small negative. It is only necessary that the lens should sharply cover the small negative. Only quarter-plate portraits could be taken with a 6-in. lens. In some cases it may be best to fit the enlarging camera with a 6-in. rectilinear lens by a good maker (such as Ross, Dallmeyer, or Taylor), working at *f*/6. This could be used as it stood for ordinary work and enlarging; whilst an occasional half-plate portrait could also be taken by using the front combination only, provided the extension of the camera is sufficient. If not, a conical front could be made to accommodate it. Every lens is supplied with a flange, which only needs screwing to the opening in the camera front. As daylight enlargements are best, it is unnecessary to have a camera for enlarging. Place the small negative in a carrier in the dark slide with both shutters drawn out, insert the slide in the camera, and place it close against the window frame, with the lens, covered with a cap of ruby glass, pointing into the room. The whole of the window, except a small opening to admit light to the slide, must be blocked out and the room rendered thoroughly dark. Outside the window must be a white reflector, at least four times the size of the negative, fixed at an angle of 45° with the negative, and receiving light from the sky. On placing a sheet of white paper on an upright easel and moving gradually from the lens, a position will be found (viz. 24 in.) where a sharp enlarged image of the small negative is shown on the paper. It is merely necessary then to pin a sheet of bromide paper on the easel and expose. Daylight exposures are constantly varying, and call for some experience, but better gradation is obtained.

Fitting Swing Curtain Rails to Iron Bedstead.—To fasten rails on the two posts of a half tester iron bedstead to carry curtains so that they will swing, Fig. 1 shows the arrangement as fixed on the pillar of bedstead. An iron bracket of wrought flat iron ½ in. by ¼ in. should be made as shown in Fig. 1, the upper



Fitting Swing Curtain Rails to Iron Bedstead.

part swelled out and drilled so as to fit over the top of pillar on the screw. The brass knob screwed down on it, with a washer between, will keep it in place. Fig. 2 shows the bottom fixing. This is a solid forging drilled through the centre to take the pin of the bracket, and with a clip for the pole fastened to it with a tightening screw. The bracket (Fig. 1) is turned up at the end, swelled out and drilled for a brass tubing to pass through; a small eye similarly made is fixed at the back end of the bracket (see Fig. 3). The brass rod should have eyes fixed into it about 4 in. apart, as shown in Fig. 4. To these eyes the curtains hang from brass hooks. The brass knob at the under side of the solid bracket rest will keep the bracket tight in its position.

Distance of Stop from Lens in Camera.—There is no arbitrary rule for finding the distance of the stop from the lens. It is best discovered by experiment; the point chosen is where the maximum of sharpness is given with a minimum of distortion. If distortion is of little consequence, the stop may be brought forward until its circle of illumination just covers the plate and no more. The experiment may be made in the following manner:—Mount the lens square in a tube and then choose another tube, 2 in. long, sliding into the first easily. (The second or inner tube may be made by rolling and pasting paper round a rod built up to the right size with paper.) At the end of the inner tube, which must be cut straight and true, fix a black card having cut in it an opening about one-third the diameter of the lens or about one-sixteenth the focus. This hole represents the stop, and by sliding one tube within the other the distance between the stop and the lens may be adjusted. Place the camera parallel with a number of straight, clear lines drawn on paper about 6 in. apart and focus them without the inner tube till they are about 1 in. apart. None of the lines will be really sharp. Insert the inner tube and push the stop close against the lens and the definition in the centre will at once be improved, but the definition at the margins will be as bad as ever. Now slowly withdraw the stop and the definition will be seen to spread towards the margins of the screen. As this is done, however, another evil is introduced; the lines at the margins of the paper are bent inwards at the ends and outwards in the centre. This bending of the lines is known as distortion, and is the result of using a stop.

Staining Wood in Imitation of Mahogany.—If the article is unpolished, it may be stained with one pennyworth of burnt sienna ground in water. Mix with stale beer, and brush well over, wiping off the surplus with rag; two coats may be given. When quite dry, rub smooth and coat with several applications of spirit varnish. The colour may be enriched by the addition of a pennyworth of Bismarck brown to 1 pt. of varnish applied with a camel-hair brush.

How to Make a Cheap Writing Table.—The accompanying illustrations show how to make a small writing table. The timber used may be common deal, in boards 4½ in. wide and ¾ in. thick; 56 ft. will be sufficient. Saw seven lengths for the back, 3 ft. 6 in. long, and twelve lengths, six for each side, 2 ft. long. The sides and back may now be either nailed or dovetailed together. Dovetailing is best, but it is the more difficult to do. If nailing is resorted to, four uprights should be obtained, 1½ in. by 1½ in. by 2 ft. 1½ in., and one placed in each corner, so that the boards may be nailed to them. When this has been done, fix the board in front (D, Fig. 1), and then nail ledges, level with the bottom of this board,

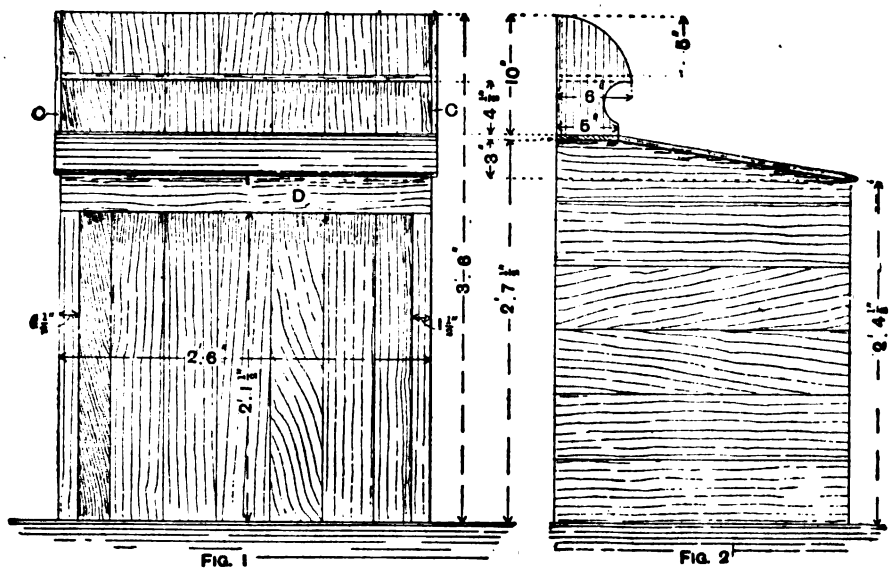


FIG. 1 FIG. 2

How to Make a Cheap Writing Table.

each side and along the back to support the bottom of the desk. The bottom may then be put on, but the wood for this need be only ¾ in. thick (an old egg case will do). Then the sloping pieces (Fig. 2) should be cut; these should be cut out of one piece. When these have been fixed on to the back and sides, the lid should be got ready; it should measure 2 ft. 7½ in. by 1 ft. 7½ in., so that it will leave ¾ in. projection each side and ¾ in. in front. Put the catch of the lock on the lid, and fasten the lid with hinges to the 5-in. board, then secure it to the sides and back. The supports for the shelf C (Fig. 1) should be cut as shown. When the shelf has been cut to the required length, 2 ft. 6½ in., it should be let into the shaped sides ¾ in., and nailed. This may now be fixed on to the top of the desk as shown in Fig. 1, and as there is ¾-in. projection at each end, the nails or screws should be driven upward. The top part of the shelf can be used for books, etc., and underneath pigeon-holes can be made, if desirable. Now fit in the lock, cut out the keyhole, fill up all joints, etc., with putty, and rub all over the table with glasspaper, and it is ready for staining.

Self-polishing Blacking.—To make blacking that requires no polishing, take 4 oz. of treacle, ½ oz. of lampblack, a tablespoonful of yeast, two eggs, a teaspoonful of olive oil, and a teaspoonful of oil of turpentine; mix well, and apply with a sponge.

Polishing Stalactites.—The principal thing in polishing stalactites and small stones after they are cut is to grade the hardness of the polishing material with the stone to be polished. For cutting a surface level, use various grades of emery on lead laps, with a separate lap for each grade of emery. See that all scratches are removed. For the polishing, on hard wood that will not warp glue a piece of buff leather. On this place a little putty powder, which, like the emery, must be used wet. The following has been given as best for soft stones:—Take, say, ½ lb. of putty powder, put it in a jar, cover it with nitric acid, and place it in the open air, as the fumes are noxious; let it stand for a day, then pour off acid and water repeatedly until the water ceases to be acid. Polish with the residue.

Curing Rabbit Skins.—To cure rabbit skins, mix bran and three or four times (by measure) as much boiling water, and add 1 lb. of alum and ¼ lb. of salt to every gallon of water. Stir to dissolve the salts, and then cover with a cloth until about new milk warm. Place the skins in this, and leave for about twenty-four hours; then dry them in the shade, stretching and rubbing them well. Stir up the mixture, and replace the skins for twenty-four hours; then dry again, repeating the stretching and rubbing. For large skins, the rubbing is supplemented by scraping the flesh side with a knife to loosen the fibres. Many now make a mixture of oatmeal and hot water, and before this is quite cold immerse the skins in it for twenty-four hours, and then dry and hand rub as before. If the rubbing has been thorough, the skins should be as soft as chamois leather.

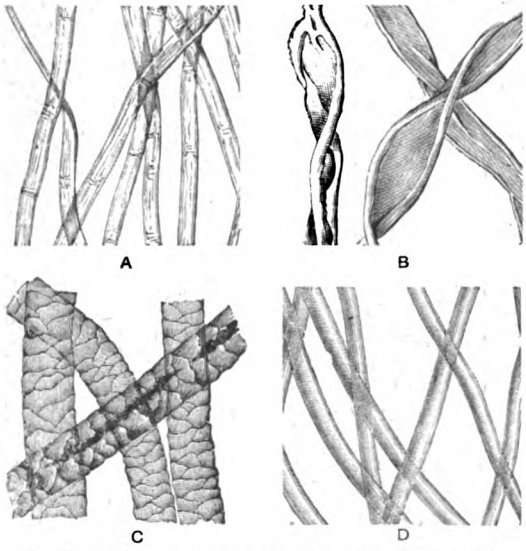
Rule for Velocity of Steam.—It has been found that the discharge of steam through an opening into a pressure less than three-fifths the initial is about 900 ft. per second. The following rule has been given to determine the velocity in feet per second when steam flows into a vacuum:—To the Fahrenheit temperature of the steam add 460, and multiply the square root of the sum by 60. The area of pipes for steam engines should be arranged so that the velocity of the steam does not exceed 130 ft. per second; a lower velocity is better.

Stereoscopic Photography.—For most subjects, except instantaneous stereoscopic work, an ordinary quarter-plate camera, with one lens only, may be used if provision is made for shifting the camera or the lens from side to side for a distance of from 2½ in. to 2¾ in.; or if the object itself can be moved the same relative distance the camera may remain stationary; or achromatic lenses, paired for stereoscopic work, could be fitted to a half-plate camera. As to plates, in a half-plate camera double quarter-plates (6½ in. by 4¼ in.) are often preferred. There should be a partition between the lenses, and this may easily be made in a square-bellows camera by pleating some flexible black material over two slips of elastic and fastening it to hooks in the camera front and in the back frame.

Distinguishing Worsted from Cotton Cloth.—The best way to distinguish a cotton cloth from a worsted cloth is to unravel the edge, and if of cotton it will have a wiry appearance; worsted is soft and woolly. But if there is any doubt, hold the threads over a lighted lamp beyond the flame; if of worsted, they will shrivel up and burn into a black cinder; if of cotton, they will remain stiff till they get red hot, when they will burn into a white ash.

Dead Black for Interior of Camera.—To make a dull black stain for the interior of a camera, mix powdered lampblack and French polish, using of the latter only just enough to make the black adhere. Too much will produce a polished appearance. Another recipe is: Aniline black, 100 gr.; gum shellac, 200 gr.; methylated spirit, 5 oz. Dissolve thoroughly, and apply with a soft brush quickly. Negative varnish and powdered lampblack may also be used.

Difference between Linen, Cotton, Wool and Silk.—To distinguish the difference between linen, cotton, wool, and silk, examine the fibres under the microscope with a moderately low power. It will be found that the linen or flax fibres consist of transparent tubes, sometimes marked with lines and having very small central canals (see A in the illustration). The cotton fibres consist of straight or twisted flattened tubes with very large central canals and quite transparent (see B). The wool fibres are very variable, but consist of a number of plates or scales built up to form a tube, and the inner tube is usually more or less coloured in the natural wool (see C). The silk fibre is usually very small and perfectly smooth (see D). The action of chemical agents upon the fibres depends upon their composition. Flax and cotton are nearly pure cellulose. By the action of moderately strong acids, the fibre is somewhat attacked, and the



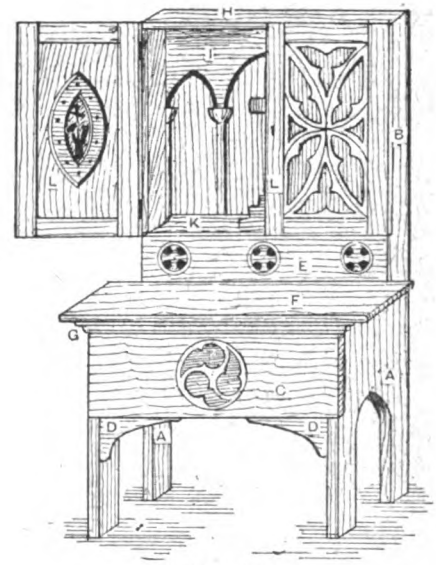
Magnified Fibres of Linen, Cotton, Wool, and Silk.

result is a parchment-like product: by long-continued action of strong sulphuric acid, cellulose is converted into dextrine, and by dilution with water and boiling it finally becomes glucose (a kind of sugar). Strong nitric acid converts cotton into nitro-cellulose or gun-cotton. Weak alkalies do not affect cotton or flax; strong alkalies toughen the fibre and shrink it, forming mercerised cotton. Wool fibre has a composition similar to skin, horns, and feathers, and is composed of nitrogenous material called keratin, but contains sulphur also. Dilute acids do not affect wool; strong nitric acid and other acids destroy it, the former first rendering it yellow. Alkalies render wool very tender: strong alkalies used hot dissolve wool completely. Silk contains fibroin, gelatine, wax, albumin, etc. Concentrated acids destroy silk, but dilute acids do not affect it much; simply boiling with water removes the gelatine or sericin, which amounts to about 20 per cent. Weak alkalies impair the silk, and strong alkalies easily dissolve the silk entirely.

Drilling Holes in Glass.—To cut a 1-in. hole in a glass plate a copper tube may be used for drilling. Use a tube about ¼ in. diameter with the end spread to 1 in. diameter. Emery powder should be fed inside the tube to form the cutting material and turpentine used to dissipate the heat. The tube must, of course, be pressed on the glass and rotated.

Flattening Buckled Copper.—To flatten copper that is buckled, hammer the surface with a light planishing hammer on a bright tinman's anvil, commencing at the end and going backwards and forwards across the metal with a series of regular blows, until the entire surface has been covered. Any hollow places along the centre of the strip must be drawn down flat by hammering from the edge of the hollow out to the edge of the strip. Should the strip be wavy or loose along the edge, hammer along just inside the edge and work back towards the centre of the strip until the edge is drawn flat.

Private Altar.—For a small private altar which can be closed when not in use the accompanying figure is suggested. The dimensions are as follows: Length, 24 in.; projection from wall, 20 in.; height of altar, 21 in.; and height of reredos above altar, 18 in. The ends A A are of inch board shaped as shown, the back length in each running up to the top of the reredos, as at B. The front is chiefly formed of a stout piece of 9-in. board C, pierced with a medallion of tracery, which is let into the edges of the end pieces. The spandrels below (D D) are separate pieces fixed to this board. A similar board, but plain, is at the back. The front of the super-altar E is ornamented with sunken medallions. This rises about 4 in. above the altar top F, and might have a projection of 5 in. or 6 in. The altar top is made to overhang at front and ends, and a bold moulding G, mitred at the corners, runs beneath it. The reredos has a piece H running along its top of the same width as its ends. Half-inch boarding will do



Private Altar

for its back, and in order to show up the cross, etc., the back might be lined with velvet, the Gothic arcade I being sawn out of thin board, worked up, and fixed upon the lining. A piece of thin board K, covered with similar velvet, should be fixed along the top of the super-altar above its true top, and will serve for the doors to fold against. The doors L L are hinged to the stout end pieces. On their inner sides the panel of each might be gilded in diaper and painted with the gold as a background; or it might be lined with velvet, on which a sacred monogram or emblem in brass could be fixed. The outer side of one of the doors is shown with its panel filled with tracery sawn from thin board, worked up with chisel and gouge, and fixed upon the wood.

Liquid used for Gold Paint.—In the manufacture of gold paint pale copal varnish, thinned with turpentine, is often used. Some gold paints are made with a white spirit varnish; others are mixed with a medium prepared by dissolving collodion cotton in amyl acetate and diluting with petroleum ether. When the bronze powder has to be mixed with the medium, pale copal varnish, thinned with turpentine, is very often employed.

Cements for Oil Lubricators. — There are two suitable cements that will withstand oil and heat. The first is made by separating the white from the yolk of an egg, and mixing the former to a stiff paste with powdered quicklime. The second cement is made by boiling together 5 parts of water, 1 part of caustic soda, and 3 parts of resin. When the resin is dissolved, the liquid is mixed with half its weight of plaster-of-Paris, and at once used, as both cements set hard in a very short time.

Making Cart Grease.—The materials employed are resin oils, resin, heavy petroleum, animal greases, soda, lime, etc. The following may be taken as examples:—(*a*) Petroleum residue 40 gal., resin 60 lb., animal grease 50 lb., caustic soda lye 2¼ gal., salt 5 lb., dissolved in a little water. The oils are heated together, and the soda lye and salt gradually stirred in, when partial saponification takes place. (*b*) Resin oil 100 lb., and slaked lime 90 lb.; heat together, and stir thoroughly until a homogeneous mass is formed. (*c*) Heat together 1 lb. of palm oil, 1 lb. of palm oil soap, 55 lb. of resin oil, and then gradually add, while stirring, 10 lb. or 20 lb. of strong soda lye, until a uniform paste is formed. These greases are sometimes mixed with blacklead, or rendered thicker and more viscous by additions of inert weighting materials, such as barytes, china clay, gypsum, etc.

Oven for Case-hardening Cycle Parts.—The construction of an oven for case-hardening cycle parts is shown in sketch. Fig. 1 is a longitudinal elevation showing the air holes at the sides. These are simply spaces for half bricks. Fig. 2 is a longitudinal section showing the brickwork construction, the outside being best red ordinary bricks with an inside lining of best quality firebricks. The hardening box is shown in position in the centre of the fire. Fig. 3 is a cross-section, not, however, taken through the air-holes. The size of the oven must be regulated by the size of the articles to be hardened. A good size for ordinary work would be 3 ft. or 3 ft. 6 in. long by 2 ft. wide.

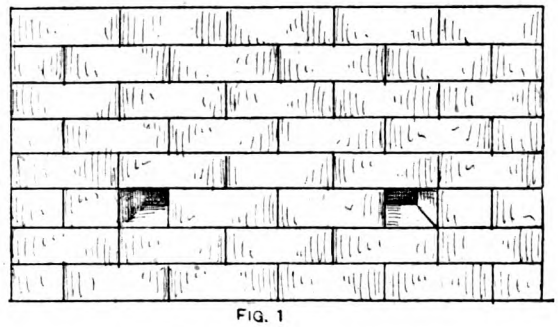


FIG. 1

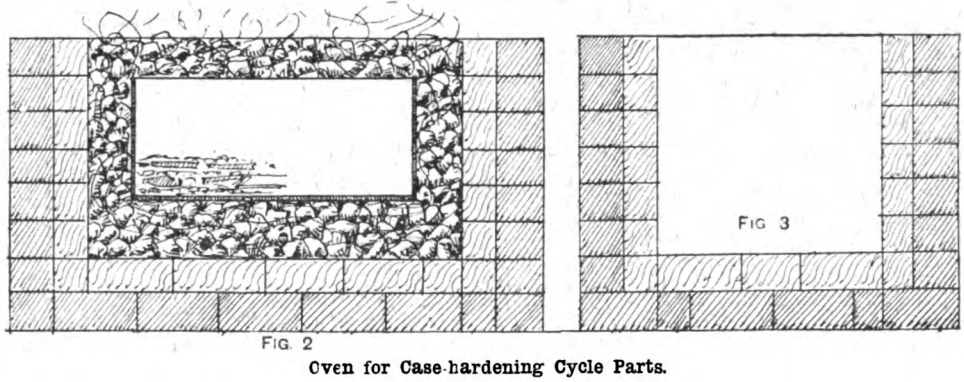


FIG. 2

Oven for Case-hardening Cycle Parts.

Easily-made Lantern Slides.—To make these, some glass cut to the size of the lantern slide, and some prints about the size of the slide, must be selected. A series illustrating travels or manufacture will be found a very suitable subject. The print is well covered with starch paste on the picture side, and laid on one of the pieces of glass, the surplus paste being worked from the centre to the edge with a piece of cloth wrapped over a cork. Great care must be taken that the paper adheres to the glass, no air bubbles being allowed to remain between the glass and the paper. When dry, with a rubber made of a piece of cork covered with the finest glasspaper, work the back of the picture off until there is only a thin film of paper left, care being taken that the paper is not rubbed through to the glass. To get an even thickness, hold the slide up to the light, when the thickest parts will show dark; these spots must be worked carefully off until the whole surface is of an even transparency. If desired, the picture may now be tinted with transparent colours. The slide is now brushed over with a varnish made of equal parts of Canada balsam and spirit of turpentine, and, when dry, mounted in the usual way. With care during the process these slides will almost equal photographic ones both in transparency and sharpness. The half-tone prints taken from photographs make excellent slides. Another simple method when hymns or diagrams for educational purposes are to be thrown on the sheet, is as follows: First get some ground glass cut to the required size. Draw the diagram, or write the hymn in a circle 3 in. in diameter on paper. Lay the glass on the drawing, or writing, ground side upwards, trace over the lines with a sharp-pointed F pencil, or with Indian ink, using a small mapping pen. Float with the Canada balsam varnish by holding the glass at one corner, pour the varnish on the centre, spread it by rocking the glass backwards and forwards until the whole of the glass is covered, and drain off the surplus back into the bottle at one corner. When dry the slide is ready for mounting.

White Acid for Glass Embossing.—Hydrofluoric acid, diluted with water, is principally used in glass etching, but there are several fluorides used for the purpose. Fluoride of ammonia is formed by adding ammonia to hydrofluoric acid until it is nearly saturated; if a slight excess of ammonia is added so that the mixture smells of it, and then a little more acid be mixed with this, the fluoride will be suitable for glass etching. The fluoride of ammonia is placed on the glass and allowed to dry, when the etching effect then becomes apparent. Another etching fluid is made by dissolving 25 parts of fluoride of potassium, 25 parts of hydrochloric acid, and 14 parts of sulphate of potash in 100 parts of water. Another solution is made by dissolving 10 parts of carbonate of soda and 10 parts of carbonate of potash in 40 parts of warm water, and then adding 20 parts of concentrated hydrofluoric acid and 10 parts of sulphate of potash previously dissolved in 10 parts of water.

Weight of Cast-iron Balls.—To calculate the weights, first determine the contents of the balls in cubic inches, and then multiply by ·26. To find the contents of a sphere or ball in cubic inches, cube the diameter in inches (that is, multiply it by itself, and then the product by itself), and multiply by ·526. Thus, the contents of a 7-in. ball equals 7 × 7 × 7 × ·526 = 179·6 cub. in., and the weight of the ball is 179·6 × ·26 = 46·81b. The weight of cast iron per cubic inch varies from ·251b. to ·271b. A simpler method of determining the weight in pounds is to cube the diameter in inches and then multiply by ·136.

Solutions for Silvering Glass.—(*a*) Dissolve 60 grains of silver nitrate in 1 oz. of water, and pour this solution quickly into a boiling solution of 48 grains of Rochelle salt in about 1 oz. of water. On cooling, filter the liquid, and make up to 12 fl. oz. with distilled water. (*b*) Dissolve 60 grains of silver nitrate in 1 oz. of water, then add ammonia until the precipitate is nearly re-dissolved, and make up to 12 fl. oz., as before. For silvering, equal volumes of these liquids are mixed just previous to using. Another formula is: (*a*) Dissolve 48 grains of silver nitrate in 1 oz. of distilled water, and add ammonia till precipitate is nearly dissolved, filter the solution, and make up to 12 fl. drachms with water. (*b*) Dissolve 12 grains of Rochelle salt in 1 oz. of distilled water, boil, and add while boiling 2 grains of nitrate of silver previously dissolved in 1 drachm of water, cool, filter, and make up to 12 fl. drachms. Mix equal proportions as stated above.

Covering Circular Frames with Plush.—Take a circular piece of plush, 2 in. to 1½ in. larger in diameter than the frame, cut all round the edges to the depth of plush that will overlap the frame; lay the plush right side down on the table without creasing it, apply round the front of the frame a touch of glue, which must be strong and not watery. Then lay the frame on the plush, and strain it tight by pulling it with the hands; then by different stages apply the glue at the back and overlap the overhanging plush, taking 3 in. or 4 in. at a time (see A, Fig. 1). Press the plush into contact with the wood with a bone paper-knife or piece of wood. When completed and nicely set, with tailor's chalk draw a circle in the centre of the plush, then cut it out with scissors; leave a margin of 1 in. or ¾ in., so as to overlap on the rebate of frame. To get the circle easily, a dinner plate may be employed as a guide. After cutting out the circle

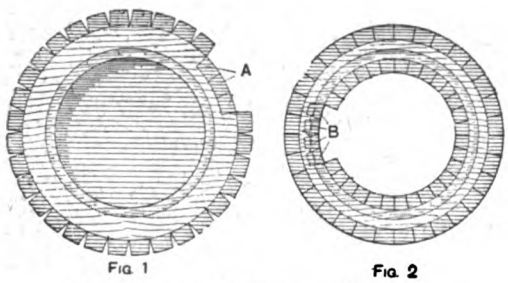


Fig. 1 Fig. 2

Covering Circular Frames with Plush.

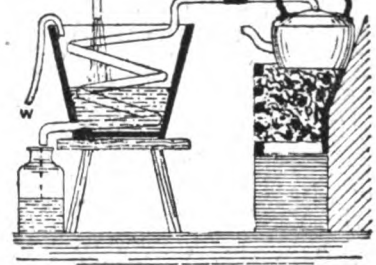
with scissors, cut the inner edge all round to the required depth. It requires great care not to cut too far, but just so that it will overlap and fit snug (see B, Fig. 2). Press it well into the rebate, a little at a time.

Selecting Portland Stone.—The chief points in the selection of Portland stone for building purposes depend upon the purpose for which the stone is required. There are four distinct kinds, of which three are usually sent into the market. The best is True Roach, 2 ft. or 3 ft. thick, consisting of a mass of fossils united by a cement composed of carbonate of lime, distinguished from Bastard Roach by its containing the Portland screw fossil: it is much used in engineering works. The Whitbed is the most useful Portland stone, consisting of fine oolitic grains, well cemented together, with a small amount of shelly matter at intervals. It is a good weathering stone, will take a fine surface and a sharp arris, and is used for the finest ashlar work. Basebed is very similar in appearance to Whitbed, but of a less roe-like texture when examined through a magnifying glass, and more free from shelly matter. Being more uniform in texture and softer to work, it is preferred by masons, but does not weather so well. It is useful for internal work and carving, and is generally known as "best-bed." All stone should be laid on its natural bed, but in Portland stone it is not so easy to detect this as in more laminated stones.

Making Marking Inks.—The only really reliable marking inks that will not wash out of linen, apart from stamping inks, are those that contain compounds of silver, gold, or platinum. Silver inks are indelible as long as the fabric lasts, but they become paler as the fabric wears away. Chloride of lime or eau-de-javelle bleaches silver marking ink, the action being to convert the black metallic silver into white silver chloride. The following recipes are for silver inks:—(*a*) Nitrate of silver 17 parts, ammonia 42 parts, carbonate of soda 22 parts, gum 20 parts, sulphate of copper 33 parts, distilled water 85 parts. Dissolve the carbonate of soda in 25 parts of water, the gum in 50 parts of water, and the nitrate of silver in 10 parts of water. To the solution of nitrate of silver add the ammonia and shake thoroughly; mix the solutions of gum and carbonate of soda and add to the silver solution; finally add the sulphate of copper and shake till dissolved. (*b*) Dissolve 2 dr. of nitrate of silver in 1½ oz. of water and add strong ammonia gradually until the precipitate which first forms is just re-dissolved, make up to 2 oz. with water, and colour with a little indigo extract, sap green, or any suitable aniline colour. It is usual to press a hot iron upon the marking so that the ink may decompose and the silver be reduced.

Making Gold Cardboard Mounts.—The openings or sinkings of cardboard mounts are cut from close-grained board made for the purpose. The surface of the cut-out mount is coated with gilders' thin matt size, which is made by mixing fairly strong size with the raw material. Generally two or three coatings will be necessary, each coat being allowed to dry thoroughly. The surface is next papered down with old emery-paper, washed, polished, and finally covered with English gold leaf. Much experience is required in this particular branch of gilding. The primary cause of failure is in getting the matt size and subsequent weak sizes too strong.

Apparatus for Distilling Water.—The still may be made from a large iron kettle and the condenser from a coil of tin pipe placed in a pail of cold water. In the kettle lid bore a 1-in. hole and solder into it a bent piece of pure tin pipe. Bore a 1-in. hole in the side of a wooden lard bucket and make a coil from three or four turns of the tin pipe; pass one end through



Apparatus for Distilling Water.

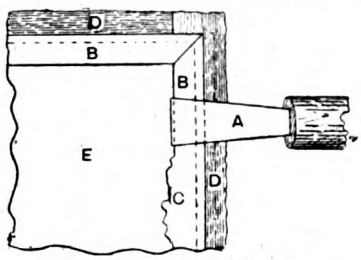
the hole in the bucket and cement it in with white lead. Stand the bucket on a stool so that the tin coil can be connected to the tube in the kettle by means of a small piece of rubber tube. The water to be condensed may be conveyed to the bucket by means of a small rubber tube or a length of compo pipe, and may be syphoned away from the top of the bucket by a bent piece of compo pipe. The kettle should be about three-fourths filled with tap water through the spout, which is then corked, and the kettle is heated on the fire or gas stove; the first small quantity of water which distils into the bottle should be thrown away and the distillation stopped before the residue is dry. For drinking purposes, the distilled water should be passed through a charcoal filter to aërate it. The sketch shows the distilling and condensing arrangement.

Making Purse Nets for Catching Rabbits.—Purse rabbit nets are square worked on a 2-in. mesh, using ten or twelve rows of the same number of stitches. Flax sewing twine, bought in skeins, is suitable. The draw line can be rove through all meshes round the net, and attached to a brass ring for pegging over the rabbit's hole, or a ring may be hitched to each corner and the line rove through the rings only, in which case the line is pegged over the hole and not a ring.

Removing Enamel from Mahogany.—To remove enamel from mahogany panels, take a bucketful of freshly made limewash and add 2 lb. of common washing soda. Apply to the panels with an old brush. Several applications may be necessary. As the enamel softens, scrape off with a wedge-shaped piece of wood. Swill off with plenty of clean water. Should this treatment turn the panels darker in tone than desired, the colour may be restored again by wiping over with oxalic acid, ½ oz. to 1 pt. of water. Swill off again with clean water, then wipe over with common vinegar to remove any trace of acid.

Transfer and Re-transfer Papers for Lithography.—To make yellow transfer paper, mix together equal quantities of best flake white and isinglass or gelatine, adding sufficient gamboge to give the required tint. Put the ingredients in water, and heat them over a slow fire until dissolved. Then strain the mixture through a piece of muslin to get rid of the coarser particles, and, while it is still quite warm, spread it, by means of a large flat camel-hair brush, on one side of smooth, thin paper cut to convenient sizes. The paper, when dry, should be passed through the press over a heated lithographic stone. To make re-transfer paper, mix in tepid water one part of best ground plaster-of-Paris with three parts of shoemakers' paste free from alum, adding a small quantity of dissolved patent glue. Strain through double muslin into a jar, and spread cool, with a flat camel-hair brush, on rather thick paper.

Replacing a Broken or Cracked Window Pane.—Knock out the old glass and putty. This can be done with an old knife worn down to about 2 in. or 3 in. from the handle. When the knife has made its way into the putty, keep it flat against the window frame and hit it with a hammer. Work all round the frame in this manner until all the old putty is removed, care being taken not to chip the window frame by driving in the knife too far. The putty being removed, get a little paint, and apply it all round the rebate of the frame, and after it has dried a little take some fresh putty in the right hand and press a thin layer round the frame with the thumb. Put in the pane of glass, press it evenly all round to bed it in the putty, and fix it on each side with two small tacks driven into the window frame with a light hammer, allowing the heads of the tacks to protrude about ¼ in. Putty the outside of the pane all round and bevel it with a sharp knife, resting against the edge of the



Replacing Broken Window.

window frame and on the glass in the manner illustrated, pressing the thumb against the side A. The figure also shows the cut putty at B, the uncut putty at C, a portion of the framing at D, and the window pane at E. The glazing is completed when the surplus putty on the inside has been removed. When ordering glass to be cut to size, first take the exact measurements of the window frame, and deduct ⅛ in. from each edge, or ¼ in. from two sides; thus: if the window frame is 12 in. by 9 in., the glass will be 11¾ in. by 8¾ in., so that if the glass or frame is not quite square the glass will still fit in, besides allowing the putty to bed against the edges. Putty can be softened with linseed oil, and is best kept in a can and covered over with the oil.

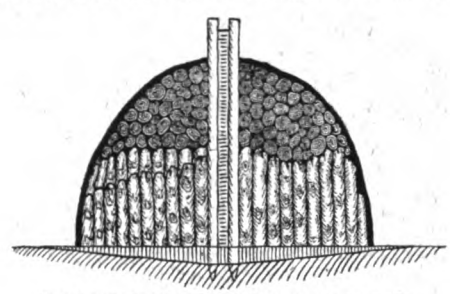
Vignetting Apparatus for Photographs.—The covers and bottoms of old plate boxes in which a hole with scalloped edges has been cut answer very well. They will stand some ¾ in. away from the negative—an essential in securing a soft vignette. The opening should be smaller than the size of the desired vignette, because the light spreads under the box. For head and shoulders, a pear shape is about the best: where thin portions of the negative occur under the vignette, cover with a piece of cotton-wool, pulling the edge loose. If the negative is thin or the light very bright, the whole should be covered with tissue paper.

Polishing the Panels of a Brougham.—After the carriage has the full amount of varnish on, it must stand by for at least four months for the varnish to get thoroughly hard; it may then be very lightly faced down with pumice-stone and water, and polished up with rotten-stone and linseed oil, using a rubber of some soft material. Should it have a dull look when finished, owing perhaps to too much oil being used, rub over briskly with a mixture of equal parts of vinegar and oil applied with a pad of cotton wadding.

Speeds for Turning and Boring Metals.—For turning cast iron the speed of the job past the tool may be 150 in. to 190 in. per minute; for wrought iron, 260 in. to 280 in. per minute; for yellow brass, 300 in. per minute; and for chilled rolls, 3 ft. per minute. In boring, the following speeds are recommended:—For cast iron, 80 in. per minute, and for wrought iron, 140 in. per minute. For screw-cutting in steel a suitable speed is 7½ ft. per minute; it, however, should depend on the nature of the material, Bessemer steel, for instance, being turned or screw-cut at a higher speed than cast steel. To determine approximately the peripheral speed of the job in inches per minute, multiply its diameter in inches by 3½, or by 3·1416, and by the revolutions per minute.

Gilding Lines on a Boat.—To apply transfer gold leaf to gilt lines, rub the varnish down smooth and paint the lines to be gilded with equal parts of good oak varnish and japanners' gold size, into which has been worked a little powdered chrome or ochre. In about half an hour, when "tacky," apply the leaf; press in contact, and dust off the surplus with a camel-hair brush when the whole is finished.

Converting Oak Branches to Charcoal. When oak branches are so small that useful wood cannot be got out of them, perhaps the best way to utilise them would be to convert them to charcoal. Small branches are, however, not the best for making charcoal; large branches that can be sawn into 3-ft. or 4-ft. lengths are most suitable: they lie close, and there is not an excessive waste during burning. With small branches the labour of cutting up will be found to be very heavy; but if they were not cut up the branches would occupy very much space and the loss during burning would be heavy. The branches may be cut up and then stacked in a circular mound, as shown in the figure. First of all, three or four wood piles should be driven into the ground close together, so as to form a rough chimney. A ring should be marked around these piles, and four to eight shallow furrows should be ploughed in the ground from the edge of the ring to the central piles.



Converting Oak Branches to Charcoal.

The wood may now be stacked around the piles and heaped closely till it forms a mound nearly as high as the piles and nearly as large as the ring. As a protective covering, the whole mound will now have to be covered with earth, turf, or wet clay. When this is finished, the central piles may be removed, and lighted brands placed in the mouths of the furrows, when the draught produced by the central chimney will soon cause the heap to ignite. The burning should be carried on slowly; when the heat becomes excessive, it may be moderated by placing a piece of turf over the furrow and damping the earth. When smoke ceases to issue from the chimney, turf or earth should be placed over the furrows, and the whole of the covering well damped. The pile should be allowed to cool somewhat before it is pulled down.

Cooling Air.—A simple method of cooling air which is drawn by a fan from the outer atmosphere is to make a frame and cover it with coarse canvas or cloth having large interstices, and across the top of the frame carry a pipe with small holes bored in it so that water can be made to trickle slowly over the whole of the canvas. The water could be cooled with a little ice if necessary. There must be a trough or channel to receive the water at the bottom of the canvas, and the frame must be erected to fit an opening so that the whole of the incoming air will pass through the canvas. Have the frame of good size so that the air will not be forced through it too swiftly.

Brush Polish for American Organs.—For a dull finish almost any kind of soft gum varnish is generally considered good enough; for a bright finish the following formula is recommended: Shellac 4 oz., sandarach 3 oz., Venice turpentine 1 oz., oil of turpentine ½ oz., camphor 10 gr., methylated spirit 1 pt. Carefully strain before use; apply with a camel-hair brush. The best results are obtained when the work is done in a hot room. When many coats are applied, sufficient time should be allowed for the undercoat to harden properly, otherwise "checking" or shrinking, causing a cobweb appearance, will be the result. This fault is not so apparent on dull as on bright finished goods.

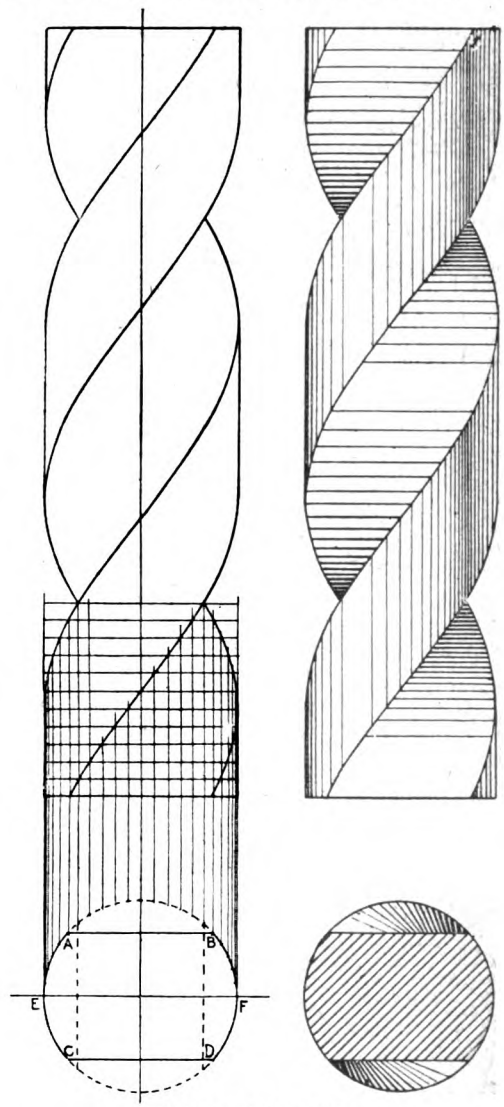
Applying Gold Bronze to Picture Frames.—Mix the bronze with japanners' gold size and turpentine, and use it with a good body. The paint will never look equal to gold leaf; its durability will be increased, however, by coating with varnish.

Door Curtain to Contain Autographs.—A suggestion is here given for carrying out a design of an autograph door curtain, to be worked with coloured silk on a cloth ground. The curtain is 8ft. long by 4ft. in width. The border is arranged to have a scroll of leaves on a stem, the leaves being worked all over so as to give

Design for Door Curtain.

a mass of dark colour. If the leaves are shaded green and the stems a rich brown a good effect will be produced. Winding round this wreath is a ribbon on which the autograph might be sewn; this will give a pretty appearance without detracting from the general artistic effect. The scroll across the upper section of the dado of the curtain is also arranged to take autographs. This dado should be filled in with dark masses of colour. The central portion of the curtain might contain the outlines and stems of the leaves worked in shaded silk, the branches being in shaded browns, and a little more fully worked than the leaves. The fruit might be in silk of a brighter colour so as to add brilliance to the composition. The leaves and fruit may be used for the autographs if required, that is to say if the spaces in the border and the top of the dado are not sufficient; but it is suggested that the autographs should be placed on the fruit first and then on the leaves, as the artistic effect will be better. The colouring must be left to the taste of the worker, and will depend much on the colour of the cloth adopted for the curtain.

Projection of Spiral Curves.—Assuming a parallel spiral, the method to be adopted is the same as that for the projection of a helix or single spiral line on a geometrical cylinder. The points A, B, C, D, in the accompanying illustration, when projected, give the



Projection of Spiral Curves.

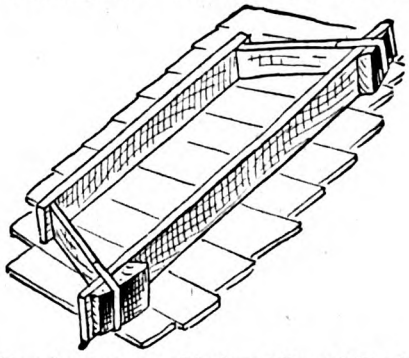
lines in the elevation, while points E and F give the diameter of the cylinder. The left-hand figure shows the geometrical outlines, and the right-hand figure the shaded result.

Gold-lining Picture Mounts.—To gold-line mounts for pictures, prepare a solution of strong gum arabic, and add a small quantity of moist sugar; strain through muslin. Placing a ruler where the line is required, with a quill make a full line of gum. In a few minutes the gum will become "tacky," and gold leaf, cut in very narrow strips, may be applied with a tip, dabbed down and skewed in in the u ual way. This proce-s will give a clean, durable line. Gold lines made by applying gold paint turn black in a very short time.

Keeping Water in Gas-holder from Freezing.—Mix the water with commercial glycerine, or use a solution of calcic chloride instead of water in the tank. The most practical way of getting over the difficulty, however, is to insert a steam pipe into the tank of the holder, and during frosty weather to pass steam through the pipe, taking care not to allow the temperature of the water to get too high.

Finishing Piano Cases.—Most varnished surfaces can be got to a dead level and brilliant gloss by first rubbing level with hair cloth or felt and finest-grade pumice powder, and bringing up the gloss with tripoli, crocus, rouge, or putty powder. All inequalities being removed, rub carefully with tripoli and oil, working with a circular motion till the surface is perfectly smooth and inclines to brightness. Wipe off all greasiness and well rub with dry putty and silk, and finally finish with flour, still using silk or the palm of the hand, which should be perfectly clean. It will require practice to find the most suitable varnish and the knack of imparting a brilliant gloss over the large surface of a piano.

Forming Concrete Window Sills and Heads.—Make wooden moulds, wrought inside, of the dimensions and shapes of the heads and sills, arranging one side to be removable, as shown in the sketch. Wedges driven through iron straps tighten up the mould when it is to be used. For the concrete, take one part by measure of Portland cement, one part of clean sharp sand, and three or four parts of broken stone, gravel, or broken



Forming Concrete Window Sills and Heads.

brick of, say, 1-in. gauge. Turn these over on a boarded platform while they are dry, then, while water is being sprinkled on from a watering-can, turn the whole over twice or thrice, taking care not to use more water than is necessary to bring the cement and sand to the consistency of good mortar. The mould in the meantime should be coated inside with linseed oil or soft soap to prevent the concrete sticking. It is laid on a boarded floor, and the concrete is filled in and punned with a rammer to well fill the corners of the mould and to ensure solidity. Leave the concrete about 1 in. below the top of the mould, and float up this portion with a mixture of equal parts cement and sand, so as to form a skin of finer stuff for the surface that will be exposed to view. The mould must now be left undisturbed for two or three days, when the wedges may be knocked out and the window-head removed. Before being used, the latter should be stacked away for ten or twelve weeks—the longer the better—to bring out the strength of the cement. Sills can be made in the same way, but the moulds are a little more elaborate.

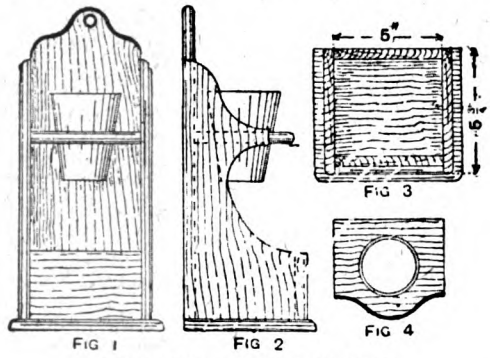
Yellow Finish on School Furniture.—To obtain the yellow or amber tone seen on chairs and stools used in schools and clubs, dark-coloured shellac is generally used if the articles are finished by French polish or spirit varnish. A more prominent colour may be gained by rubbing over with linseed oil and yellow ochre. For deal goods, size with patent size strongly tinted with yellow ochre or lemon chrome. For best-class goods the varnish may be tinted with gamboge or madder.

Testing Gaspipes and Fittings for Soundness.—The most satisfactory method of testing the soundness of gaspipes and fittings is to subject them to air pressure in excess of the pressure of the gas which will flow through them. All cocks having been carefully shut off, an ordinary pressure gauge is attached, by means of a piece of indiarubber tubing, to the nozzle of a gas bracket or pendant, and the cock turned on. Air is then forced into the main service pipe by means of an ordinary force pump provided with a stop-cock, until a pressure of about 4 in. or 5 in. of water is shown on the pressure gauge, when the cock in communication with the force pump is shut off and the gauge carefully watched. If all the fittings are sound, the level of the water in the pressure gauge will remain constant. If, on the contrary, there is the slightest leak, the liquid in the pressure gauge will gradually sink until it attains the same level in both limbs of the gauge.

Waterproofing Grey Millboards.—Dissolve 1 lb. of yellow soap in a gallon of warm water; also dissolve 1 lb. of alum in a gallon of warm water. Dip the millboard for a few seconds in the soap solution, and directly afterwards into the alum bath, and then allow to dry. Another method of applying the waterproof solution is to add the alum solution to the soap solution, collect the precipitate on a piece of muslin and dry it, then place it in a bottle and add a little benzoline; the alumina soap will gradually dissolve in this, and may be thinned with more benzoline so that it can be applied to the millboard with a brush.

Removing Oil-painted Letters from Glass.—Brush over the letters a strong solution of caustic soda, or a mixture of 2 parts of pearlash, 1 part of quicklime, and sufficient water to make it into a cream. Allow the liquids to remain on the glass for a few minutes, and then wash off with water. A second application may be made if the first does not remove the whole of the paint.

Making Soap Box and Tumbler Rack.—Any odd pieces of sound wood ⅜ in. or ½ in. thick may be used to make the article illustrated, and the several pieces when cut out are put together with round brass-headed



A Soap Box and Tumbler Rack.

screws. The back board measures 14½ in. long by 5 in. wide, and the side pieces 12 in. long by 5½ in. at the widest part. The tumbler rack is cut from a piece of wood 5 in. by 4½ in., and shaped as shown in fig. 4, a round hole being cut in the centre to receive the tumbler. After all the pieces are cut to their proper shape, rub them well with sandpaper, and fix them together. Two or three coats of oil or varnish will help to preserve the wood from continual dampness.

Preparing End Grain Wood for French Polishing.—Cabinet-makers finish the end grain of wood ready for polishing with a finely set iron-faced plane, and where this does not leave the wood sufficiently smooth the steel scraper may be used. Some cabinet-makers use glass-paper held tightly over a pad of cork, wiping over with glue water or polish to raise or swell the grain during the operation. As this dries out it binds the fibres together, thus producing a hard, dry, smooth surface.

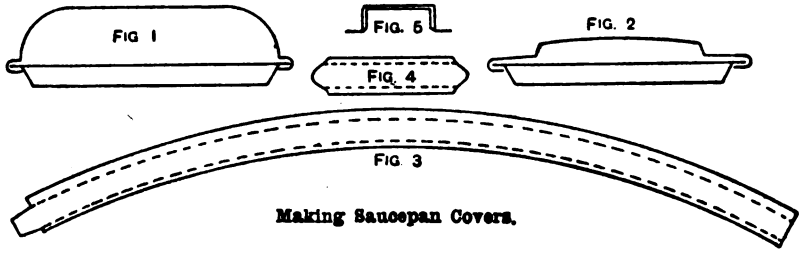
Making Stereotyper's Flong.—Flong may be made with two sheets of soft but tough matrix paper and four sheets of strong tissue, put together with stereotyper's paste. The paste recommended by an American authority upon stereotyping consists of 6½ lb. of Oswego starch, 2½ lb. of wheat flour, mixed in 6 gal. of water until all lumps are dissolved. Add 12 oz. of common glue dissolved in 2 qt. of water, and 2 oz. of powdered alum. Boil, stirring constantly, until the mixture becomes sufficiently thick. Let it get cold; then take what is required for a day's use, and add one-half the bulk of powdered whiting. Incorporate thoroughly, and pass the mixture through a sieve having about twenty meshes to the inch. Lay one sheet of the matrix paper (previously soaked in water) on a smooth flat surface; cover with a thin layer of the paste, well rubbed in. Next lay on a sheet of tissue, and smooth it down with the utmost care, using either the hand alone or an iron roller. Then add paste and paper alternately until four sheets of tissue have been added to the two sheets of matrix paper. Backing paper may be added after the flong has been beaten into form. If placed under a wet blanket, the flong will keep good for several days.

Facing and Staining Picture Frame Mouldings.—Patent or glue size and best whiting mixed and spread on like paint is generally used; several coats may be given. Or plaster-of-Paris and whiting in equal parts could be used. When quite dry, smooth down with glass-paper or, better still, pieces of pumice-stone of various shapes to fit the hollows, rounds, etc., using a coat of thinned-out whiting and size as a lubricant, wiping off the surplus with rag and clean water. To stain black, mix a quantity of vegetable black or lamp-black in 1 part French polish and 3 parts spirit. Then polish with ordinary polish stained an intense black by adding a small quantity of aniline black spirit dye.

Polishing Razors.—To remove from a hollow razor the marks caused by grinding, a glazer is required. This may be of wood only, or wood covered with leather on the edge, which must be dressed with emery of the various grades. The razor must be laid lengthways on the glazer. The polishing should be effected with crocus powder. The emery powder and crocus must be mixed with mutton suet to a thick paste.

Re-colouring Bronzes.—Imitation bronzes, made of spelter metal, may be restored by careful washing, polishing with soft chamois leather, and lacquering warm with best silver lacquer. Re-bronzing must be done by electro deposit. Real bronzes may be restored by completely covering them in the sand of a brass and copper foundry, taking them out from time to time at intervals of two or three days, and rubbing them with soft chamois leather. When the desired colour is obtained they may be lacquered with colourless lacquer; or if not lacquered, they will, if rubbed from time to time, improve in colour.

Making Saucepan Covers. — Saucepan covers of copper and tin are made in two shapes, as shown in section by Figs. 1 and 2. To make a cover like Fig. 1, bend a thin strip of metal to the shape of the section; this strip of metal when straightened out flat will give the diameter of the circle for the cover in the flat. If a number of covers of one diameter are required, they are usually hollowed in "tacks" of four or six, according to the strength of the material. A wood block containing a slight hollow and a bullet-faced hammer are required. Hold the edge of the covers over the hollow in the block, and, using the roundest face of the hammer, drive the metal down to the hollow, working round the edge with regular blows, and continue working round in a series of concentric circles towards the centre until the cover is hollowed to the desired height. Again commencing at the edge, with light, regular blows, go once more over the hollowed surface until it is smooth. Now separate the covers, and, with a burring machine, throw off a flange proportionate to the size required (usually about ¾ in. to ¼ in.). The cover shown in Fig. 2 is begun in the same way as Fig. 1, but when hollowing it is pitched up in a deeper hollow with the heel of the hammer, or with a hammer specially made for the purpose, until the ridge shown in the illustration is formed and the outer edge is left all puckered. Assuming that the cover is to be finished without the use of a swage, the edge on the top of the cover should be worked up sharp with a mallet upon a bright round head; then form the side of the ridge, worked round carefully, with a square-faced hammer (the front edge of which has been rounded off) upon a bevel stake. The outer flange may then be thrown off upon a bright anvil, using a mallet to remove the puckers, and a round-faced bright hammer to work it down to the shape. The cover should then be planished smooth and true, and the top also planished to finish it. From this point the working of both covers is the same. Cut from an arc of a circle, equal in length to the circumference of the body the cover is to fit, a rim about 1 in. deep, with allowances for flanging and edging, as shown by Fig. 3; then work over an edge along the dotted line on the inner curve, and flatten this edge down so as to stiffen the rim. Turn the rim round, fit it to the body, and solder it together at the ends. Then, with the burring machine, throw off a flange along the top edge of the rim. Now with the same machine take up on the covers an edge of such a size that the flange of the rim will fit into it. Pene down the edge of the cover upon the flange of the rim. Cut out a handle as shown in Fig. 4, wire it along both edges, bend it to the shape shown by Fig. 5, and rivet on.



Making Saucepan Covers.

Background for Photographic Portraiture.—For a background for full and three-quarter length portraits, a light bluish grey is the best colour. It should not be a flat tint, but graduated with soft clouds of various shades. To make such backgrounds requires considerable skill. As a makeshift for occasional work, the sheet may be stained with coffee to a light brown. If it is to receive a flood of light, it may be darker, and if in the shade, lighter. The exact tint is best found by experience. Or Maypole soap may be used, in which case an orange yellow should be chosen. In any case, the background should be stretched tight on a frame or suspended from a roller with a rod at the bottom. Creases are very objectionable.

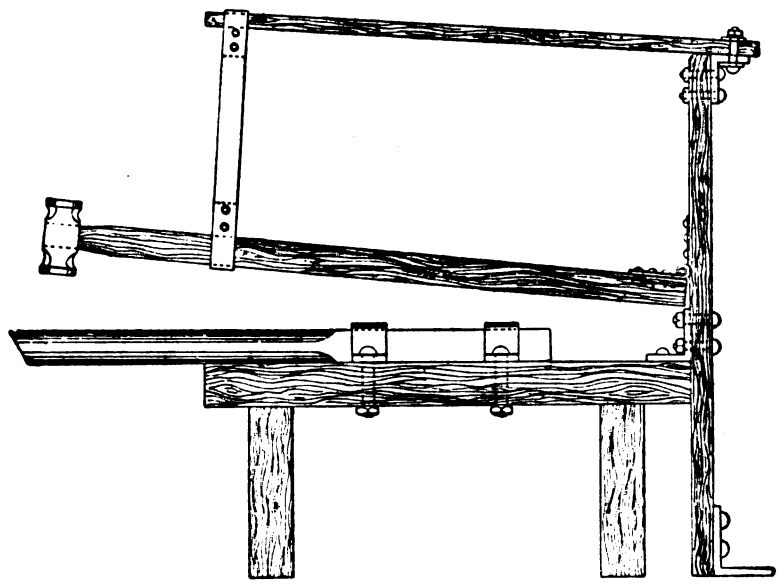
Making a Plaster Relief from a Photographic Negative.—To make a bas-relief in plaster-of-Paris from a photographic negative, the process briefly is as follows:—Soak a sheet of No. 4 gelatine in a solution of bichromate of potash, made by dissolving 1 dr. of bichromate in 6 oz. of water; allow this to dry slowly (generally taking twenty-four hours) in contact with waxed or French-chalked glass. The glazed surface thus obtained is placed in contact with a suitable negative, that is, one containing considerable contrast combined with good gradation, and exposed to the light. In half an hour, or in five or six hours, according to the strength of the light, a faint image will have been printed on the gelatine. When printed, the gelatine is firmly cemented to a sheet of glass with isinglass or other powerful adhesive, and allowed to soak in cold water for about six hours, afterwards soaking for a further time in a 1 in 4 solution of citric acid, and finally in water. When the utmost possible amount of relief has been obtained, the superfluous moisture is carefully removed with the edge of a blotting board, and oil is poured over the gelatine mould, and then drained off. The gelatine relief is then placed in a dish, and the plaster poured over it and allowed to set, after which the relief may be pulled off. The relief thus obtained is generally rather false owing to differences in colour—particularly if isochromatic plates are not used—being grossly exaggerated. Much may be done by skilful retouching.

Gold Veins in Book Edge Marbling.—The gold veins in marbled paper, or on the marbled edges of books, may be produced as follows:—Let the rest of the marbling be thoroughly dry. Then beat well together 1 part white of egg, 1 part spirit of wine, 2 parts water. Let the mixture get clear, then wet a small portion of gold powder (shell gold will do), mixing well with the finger, and apply with a small camel-hair pencil. Let it get thoroughly dry before burnishing, which should be done with a polisher made only moderately warm. The beginner should make several experiments before proceeding with the actual work.

Waterproof Dressing for Overalls. — Unbleached calico or drill sheeting is generally used for making overalls; all the seams should be double seam. For a dressing, really good boiled oil is perhaps the most durable, though some sailors prefer raw oil, but both take a long time to dry and are apt to become sticky. The following is safer for oilskins not in constant use: boiled oil 8 parts, turps 2 parts, and melted beeswax 1 part. Warm the oil, add the wax, stir in the turps, and apply warm. The first coat must be well rubbed in. In an hour or so wipe off any surplus that may have drained down to the lower edge. When thoroughly dry, add equal parts of boiled oil to the former mixture, and lampblack or ochre as desired. With this paint give the material two more coats, letting each dry thoroughly in a cool, shady place.

Remedy for Smoky Chimney.—The most prolific cause of smoking with open ranges is the large open space that exists over the range and forms the mouth of the chimney. The draught in these ranges is not very keen at the best, and the large area allows quite cold air to rest there and to pass freely into the chimney, with the worst possible results on the up-draught of smoke and heated air. This is overcome by the use of a blower, which is a sheet of metal carried across the front of the range opening at the top, from jamb to jamb of the mantelpiece. This causes all air entering the chimney to come closer down to the fire and receive warmth, for while cold air impedes the up-draught, hot air accelerates it. A cranked metal pot will often prevent the down-draught, whilst a blower will stop the general smoking. The blower can be made temporarily of cardboard or paper to find the depth required.

How to Make a Metalworkers' Mandrel Dolly.—A mandrel dolly is made by first fixing the mandrel securely to a strongly made bench, by means of iron clamps passing over the square end of the mandrel, and holding them in position by nuts and bolts, as shown. On the end of the hammer shaft an iron hinge is fixed,



How to Make a Metalworkers' Mandrel Dolly.

and when this is done, the hammer should be held flat and true in position upon the mandrel, and the position at which the vertical part of the hinge is to be fastened to the upright carefully marked. Then secure the hinge in the required position. Now fasten a stout lath of ash, to act as a spring, at the top of the upright beam to an iron bracket, as shown, and over the opposite end of the lath fasten a leather strap; then fasten the lower end of the strap round the hammer shaft, so that the hammer is held suspended about 8 in. above the work. When using the hammer, grasp the shaft close to the hammer head, and swing it down against the resistance of the ash lath to produce a blow upon the mandrel.

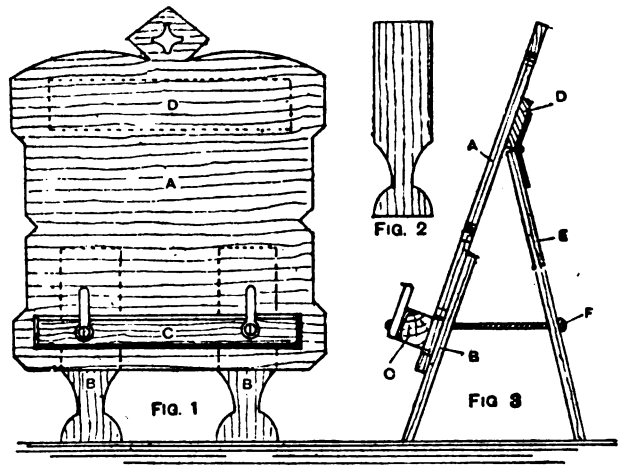
Paste for Laying Linoleum and Oilcloth.—To make cheap flour paste suitable for laying linoleum and oilcloth, mix rye flour with a little cold water, then add *boiling* water, well stirring the paste while the water is being poured. Melt some glue size and add to the paste while both are hot. Stir well. The more size is added the greater the strength of the paste. As a rule, "Inlaid" linoleums require very strong paste. A little alum dissolved in the paste is a preservative. If the paste is too thin, boil it, to evaporate some of the water.

Converting Bacon Cuttings into Soap.—The fat is first rendered in a large cylinder with an inlet for steam, exits for water and melted fat, manholes for charging and withdrawing fat, a false bottom for the latter to rest on, and a safety valve weighted to a pressure of two or three atmospheres, that is, 30 lb. to 45 lb. per square inch. The rendered fat is then run into cold water and removed for soap making, which is usually carried out in immense pans heated by fire and steam, either alone or together. The amount of materials put in the pan should not more than two-thirds fill it, so as to allow of frothing. The lyes are made by adding caustic soda to water. Two lyes are often employed, and usually three, one at 10° Tw. (4 per cent.), one at 16° Tw. (6¼ per cent.), and the other at 24° Tw. (8¾ per cent.). The fat is run into the pan, and the weaker alkali is gradually added while boiling; the stronger alkali is then added, and the mass boiled for several hours until clear. The pan is then allowed to settle, salt added, and, after thorough stirring, the waste lye may be run from the bottom of the pan. The strongest lye may now be added gradually, boiling and stirring thoroughly until the soap boils clear; then allow to settle again, and run off the soap into frames, taking care that any waste lye at the bottom does not go along with it. The strength and amount of the different lyes vary, but on the average 15 lb. to 16 lb. of caustic soda are employed for 100 lb. of fat.

Stitching a Square Edge to the Cushion of a Couch.—To stitch up the front edge of a couch seat so as to procure and retain a fine point, the tools required are a double-pointed 8-in. mattress needle, a regulator, which is something like a broad flat packing needle, and a ball of strong twine. Insert the regulator about 4 in. from the front edge of the seat, and work the flocks, or whatever the stuffing material is composed of, well up to the edge, pricking the regulator in about every 6 in. The first stitch is known as the blind stitch, as it cannot be seen on the top of the seat. Thread the needle with twine, pass it through the front a little below the stuffing rail, and out at the top of the seat about 4 in. from the front edge. Without pulling the needle right out, back it out again on the front 1 in. beyond the point at which it was first inserted. Repeat this operation along the whole of the front, pulling the stitches tight; that will draw all the flocks within the stitch on to the front edge of the stuffing rail. Now insert the threaded needle again about ½ in. higher than the last stitching; pass it through the top of the seat, and re-insert it about 1 in. farther on, stitching through backwards and forwards, letting the needle come out midway between the last stitches: pull the stitches up tight, and repeat the process as often as necessary, every row of stitches coming nearer the edge, until a fine point has been obtained. The edge, when finished, is similar in appearance to two or three coils of rope. Should the edge be very soft, or give in the middle, the stitches will be found to be slack or the rolls not stuffed firm enough. Take particular care to use the regulator before every row of stitches.

Cement to withstand Paraffin Oil.—Glue is one of the best materials for withstanding paraffin or any other oil. Another cement is made by dissolving 1 part of caustic soda in 5 parts of water, and boiling with 3 parts of resin till dissolved. Afterwards stir into it about half its weight of plaster-of-Paris or chalk, and use at once, as it hardens rapidly. This cement would take the place of red lead or white lead. Common yellow soap is also recommended for withstanding paraffin.

A Table Book-rest.—Procure a board 13 in. wide and ¾ in. thick, planed smooth and as free from knots as possible. A piece 15 in. long, shaped as shown in Fig. 1, forms the board A (Figs. 1 and 3). The star at the top of the board may be cut with a fret-saw. Rub with glass-paper and make all the edges quite smooth. Cut two pieces 8 in. by 2½ in. for the feet, and shape as shown in Fig. 2. When smoothed, screw them to the back of the board, in the position indicated by the dotted lines, at B (Fig. 1); see also B (Fig. 3). Procure a piece of wood 11 in. long by 1½ in. square for the rest C (Figs. 1 and 3), bevel the edges as shown in Fig. 1, and secure it to the front of the board by screws put in from the back. Procure two pieces of sheet brass 2 in. long by ¼ in. wide, and about ⅛ in. or ¼ in. thick. Drill a hole about ¼ in. from one end of each strip, file the strips to the shape shown in Fig. 1, and screw them to the rest with round brass-headed screws. Cut one piece of wood 10 in. by 2 in., and screw it to the back of the board 3 in. from the top, as indicated by the dotted lines at D (Figs. 1 and 2). Cut another piece of wood measuring 12½ in. by 3 in. for the support E (Fig. 3), and secure it to the centre of the cross-piece D with a 1½-in. back-fold hinge, as shown in the illustration. Procure a piece of fancy cord, secure one end to the board, insert the other end in a small hole bored through the support, and make a knot to keep it in place, as shown at F (Fig. 3). Make all the edges and corners quite smooth. The book-rest will look very well indeed if made of walnut and finished by French polishing. When in use, it is placed upon a table, and the support adjusted by means of the cord.



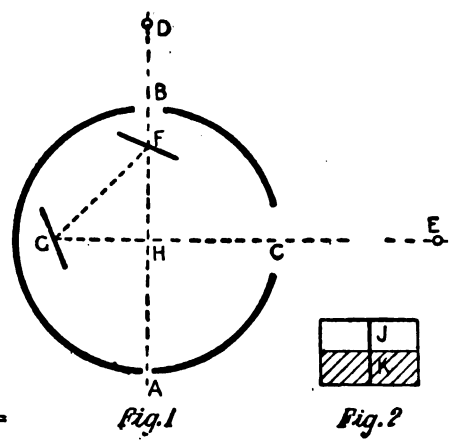
How to Make a Book-rest.

Regilding Soldered Joints of Plated Goods.—An electro-gilding solution made as follows is required: Dissolve 1 oz. of potassium cyanide in 1 pt. of distilled water made hot in an enamelled iron saucepan; suspend in this two strips of pure gold attached to copper wires and connect to a battery of two Bunsen or Daniell cells for an hour or more. Remove the strip of gold attached to the zinc element of the battery, and substitute a strip of silver. If this takes a nice gold colour, the solution will be fit for gilding. If not satisfactory, pass the current through the hot solution until it will gild properly. The cost of cyanide and water will be only a few pence.

Ascertaining Flash Point of Oils.—The flash point of oils is determined in two ways—by the "open test" and by the "close test." By the first method a small porcelain or metal dish is partly filled with the oil and placed on a sand bath heated by a burner; a thermometer suspended with the bulb in the oil registers the temperature. As the temperature rises a lighted taper is quickly passed over the surface of the oil, and when a faint vanishing flame is noticed, the temperature is read off; this is the flash point. For the close test method the apparatus devised by Prof. Abel is employed; this is fully described in the Petroleum Act of 1879. The apparatus is really a jacketed copper water-bath heated by a burner; the oil is contained in a small cup fitting into the lid of the bath, and there are thermometers in the bath and oil cup. The oil cup is covered with a lid and a slide, and hinged to it is a small spirit lamp. When the slide is drawn out the spirit lamp is tilted over the oil cup so that the flame is right over one of the holes in the lid, and on replacing the slide the lamp assumes its vertical position again. The testing is done by drawing the slide, which brings the spirit lamp in contact with the vapour from the oil cup; when flashing occurs the temperature is noted on the thermometer immersed in the oil. Water is used in the bath for oils which flash below 100° C. (212° F.), but for oils which flash above that temperature mercury must be employed.

Heating Cylinder from Two Fires.—A breakfast room grate and a kitchen range, if the two fires are back to back, can be utilised to heat a cylinder. There must be a boiler in each fire, the saddle boiler in the range being connected to the cylinder in the usual way, and the boiler put in the grate fire will be connected either to the pipes from the range boiler or independently into the cylinder. By this arrangement either boiler will do all that it is capable of doing towards heating the contents of the cylinder, and they will work separately or together without trouble, and without the use of stop-cocks or anything of this kind. No alteration is needed to the flues of either stove.

Use of the Optical Square.—This is an instrument 2 in. diameter by ¼ in. thick, to be held in the hand and arranged as shown in the accompanying figure, in which A is the sight hole where the eye is placed, B and C are openings in the rim through which rays of light can enter from poles at D and E, only farther off; F is a glass half silvered and half plain, the junction line being in the plane of the instrument: G is a whole mirror. In using the instrument for sighting poles as shown, it would be held in the left hand; with the eye at A, the pole D would be seen through the opening B and the plain part of the glass F; the observer being at the point where a right angle would be measured between D H, E H. Rays of light from pole E will reach mirror G and be reflected from there to the silvered part of glass F and thence to the eye at A, so that the glass F will appear like Fig. 2, the piece of pole J seen by direct vision being exactly over the piece of pole K seen by reflection. If in using the instrument the poles do not coincide, the station of the observer must be shifted until they do, or as an alternative one of the poles must be shifted. If the poles appear to coincide at the junction of the glasses but not to be in a straight line, it will be due to one of the poles being at a higher level than the other.



An Optical Square.

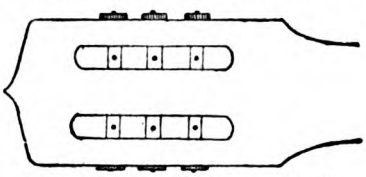
Making Blowers for Register Stoves.—Commence hollowing the semicircular blower by working round the circular part with a series of regular blows from a bullet-faced hammer, and holding the edge of the metal over a shallow hole in the hollowing block. This will curve the metal to a slight depth round the edge. Then bend the metal about 1 in. from the edge along the straight part, so that it makes a sharp angle; this will keep the bottom stiff while the remainder of the hollowing is done. Now commence on the circular part again, and work round from the edge in towards the centre, in a series of concentric circles, working it in a deeper hole if necessary than that used for commencing in. When the blower is hollowed to the depth necessary, go over the hollowed part again with a series of light regular blows until it is rendered smooth. Knock out smooth the break along the bottom, and then bend the ends round to the same curve as the hollowed part. A few blows from a flat-faced hammer, delivered upon the centre or flat part of the blower, may be necessary to set it so that it will be free from twist.

Value of Gold and Silver. — Gold has a fixed market value per ounce which never alters. Pure gold (24 carat) is worth £4 5s. per ounce troy; 22-carat gold (guinea gold or wedding-ring gold) is worth £3 17s. 11d. per ounce troy; 18-carat gold is worth £3 3s. 9d. per ounce; 15-carat gold, £2 13s. 1½d.; 12-carat gold (half gold, half alloy), £2 2s. 6d. per ounce; 9-carat gold (the lowest quality that is hall-marked in England) is worth £1 11s. 10½d. per ounce. The value of silver fluctuates according to the market; it has been worth 5s. per ounce troy, and it has fallen to 2s. The London market value of silver will be found in most daily papers under the heading "Market Reports," amongst the "London Metals."

Cause of Clicking Noise in Hot-water Pipes.—The clicking noise that proceeds from hot-water pipes after hot water has been drawn is caused by the expansion of a pipe (or pipes) when suddenly heated. If the pipe is cold, as is probably the case, before water is drawn off, it becomes suddenly hot when a tap is opened, and begins to expand lengthways. Wherever the pipe is so tightly fixed that free expansion is impeded, the resistance is overcome with a little jerk that causes the clicking noise. Pipes laid under floors across joists, where notches are never cut very deep, often give out the noise described. The same thing sometimes happens with circulating pipes as well as branches, though, in this case, it may be the sudden cooling and contraction of the pipes that cause the noise.

Purple Stain for Wood.—To make a purple stain, obtain 1 lb. of logwood chips or ¼ lb. of logwood extract, ¼ lb. of pearlash, 2 oz. of powdered indigo, and 3 qt. of water. Boil the logwood till the full strength is obtained, then add pearlash and indigo. The stain may be used hot or cold.

Fitting Worm Screws and Raised Frets to a Banjo.—To fit worm screws and raised frets to a banjo, get a pair of plates with machines fitted, and adapt them to the head of the banjo by squaring the



Fitting Worm Screws to a Banjo.

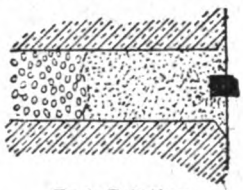
"scalloped" sides and slotting the present holes quite through, similar to the sketch. Raised frets are fitted by making a "saw cast," putting in a little powdered shellac, heating the fret-wire, and pressing it into place. Specially prepared fret-wire can be obtained for the purpose.

Varnish for Cork Frames.—For a varnish suitable for cork frames intended for indoors, there is nothing to equal spirit varnish, which consists of methylated spirit 1 pt., shellac 4 oz., and resin 2 oz.; it dries quickly and gives a glossy finish; a cheap quality will do. Apply in a warm room, and well stipple it in all crevices. Thin out with spirit for the first coating, but use it thicker for the second or finishing coat.

Roughcasting Walls.—The walls are first plastered with lime and hair mortar, having, for the best class of work, some cement added to improve it. After this has set, a second coat of mortar, mixed so as to be fat, is spread as evenly as possible over the last coat, and while this is quite soft the stones to be used are dashed forcibly against the work, to which they adhere. Care should be taken to see that the sand and stones or pebbles used are free from dirt, and if any clay is found mixed with the sand it will require washing. The stones should be screened so that they will be of about the same size. Sometimes a coat of lime-white and sometimes ochre is used for colouring the roughcast.

Felling a high Chimney Shaft.—To ensure that the stalk shall fall in a narrow compass, it will be desirable to fix three guy ropes from the top, equally divided round the circle, and made fast at a distance from the base of the shaft at least equal to half the height. Openings should be cut in the brickwork of the base on opposite sides, and 9-in. by 9-in. studs inserted, about 4 ft. long, between 9-in. by 3-in. plates running through the thickness. Before making the openings, 9-in. by 3-in. raking shores both ways should be fixed at each corner of the base. Two openings in each side, with a brick pier left between, would, in the writer's opinion, be required; and when this is done, if there is no sign of cracking or settlement, and the studs are taking a good bearing, the intervening pier in centre of each side may be cut away. Everything must be done systematically, working at opposite sides in turn. Waste wood should then be piled round the base in sufficient quantity to ensure that the wood studs will be burnt through, and lighted at several points. A couple of look-out men during the operations should be posted sufficiently far off to command a view of the chimney from two directions at right angles, and near enough to warn the men if any signs of premature falling were to occur. Local circumstances and the construction and condition of the chimney stalk may render some variation on the above method desirable. A cheaper method, and one that would probably be satisfactory in the hands of an expert in explosives, would be to explode a small charge of dynamite in the bottom of the shaft, or to bore holes round the base and insert charges of gunpowder, to be fired simultaneously.

Tuck Pointing Brickwork: Methods and Materials.—The ordinary process of tuck-pointing is as follows. The joints of the work to be pointed are raked out to the depth of ¾ in., then filled in with stopping. If the stopping is not coloured, all the work is rubbed over with a soft good-coloured brick, so that the joints may look like the face of the bricks. A small groove is formed along the centre of the joint, and, the mortar having been allowed to set a little, this groove is filled up, for white tuck pointing, with white lime putty, till a raised line of putty projects beyond the face of the joint (see illustration). The edges of the white line are cut perfectly parallel by the pointing knife held against a straightedge, and drawn along so as to remove the superfluous putty, leaving a line, about ¼ in. to ½ in. in width, standing out beyond the face of the work as far as it is possible to make it. This gives the work the appearance of being a good piece of brickwork, executed with square-edged bricks and clean white joints. The effect, however, does not often last long, the first sharp winter usually playing havoc with the projecting joints. If the pointing is to last, it is better to use the ordinary weathered joint executed in cement.



Tuck Pointing.

White lime putty is made of pure lime slaked with water and strained off while hot (the consistency should be about that of cream); it is then mixed with washed silver-sand—but a better material is marble dust—in the proportion of 2 or 3 of sand to 1 of lime. Blue pointing mortar is made by using sifted cupola or forge coal instead of sand, and black pointing has lampblack added to the other materials. Small sections at a time should be prepared for pointing, for if the mortar is allowed to set hard, a groove for the white line will be difficult to make. To colour the work for yellow bricks, use 1 lb. of green copperas to about 5 gal. of water; for red bricks, 1 lb. of Venetian red and 1 lb. of Spanish brown to 1½ gal. of water; the quantity of colour must be varied according to the tint required.

Watch Carried in the Pocket Losing Time.—All watches (except extremely fine ones) lose to a certain extent in the pocket and go faster when lying horizontally, the difference varying from thirty seconds to one minute per day. It is caused by the more free vibration of the balance when poised on the end of one pivot only than when resting on the sides of two pivots, as it does when in the pocket. If the difference in a watch exceeds one minute per day, most likely the balance is not truly poised—that is, it is heavy at one point of the rim—and acts more or less as a pendulum when the watch is vertical. To remedy it, remove the balance and take off the hairspring. Then place the balance with its pivots resting on two finely polished straightedges, on which it can roll freely and be tested for poise, any fault being corrected by means of the screws in the rim (if it has them) or by filing, if it is a plain balance. Poising tools are sold for this especial purpose.

How to Make Silver Bronze Powder. — The best silver bronze is made by mixing silver leaf with honey or gum water, and grinding to powder in a mortar, after which the powder is washed with water and dried. For a common silver bronze, melt together 1 lb. of bismuth and 1 lb. of tin, and add ½ lb. of mercury. Pour the amalgam on to a cold surface and grind to powder in a mortar. Another form of silver bronze is simply pulverised white mica.

"Marine" Glue.—Marine glue is made from 1 part of indiarubber (cut into shreds) and 12 parts of coal-tar naphtha; these are kept in a bottle in a warm place and shaken from time to time till the rubber is dissolved. then 20 parts of powdered shellac are added, and shaking is continued until the mass becomes pasty. It is then poured on to a cold surface, allowed to solidify, and then broken up into small pieces, which should be melted and applied as thinly as possible while still warm. Great care must be taken in making this cement, as the naphtha is very inflammable.

Making a Child's Chair.—The strong useful chair illustrated below is suitable for children in their teens, and will stand wear and tear for a great many years, provided it is made from a hard wood. All the spindles can be made with spokeshave and plane, and also the top for the back and seat if desired; or they can be obtained cut to pattern for a few pence extra from any timber merchant. For the seat, a piece 16 in. by 12 in. by 1½ in. is required, cut to the shape shown at Fig. 3. The underneath part can be left in the rough. Bore through it fifteen holes ¾ in. diameter in a slanting direction, at distances given on Fig. 3. Into the holes at the sides fit eight spindles 10 in. long (9½ in. when trimmed flush), ¾ in. diameter, tapered at the ends so as to fit tight in the holes made for them; these spindles form sides for arm-rests. For the arm-rests two pieces are required, 12½ in. long, 1½ in. wide, and ¾ in. thick, cut to

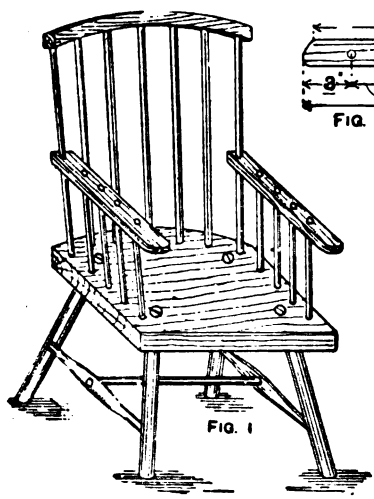


FIG. 1

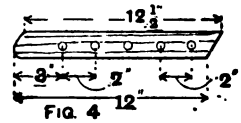


FIG. 4

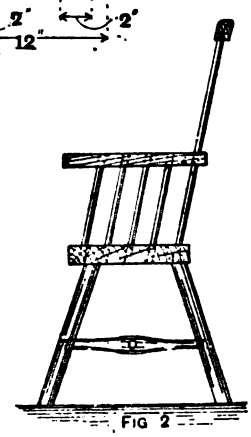


FIG 2

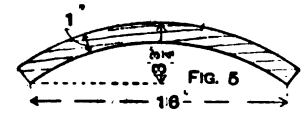


FIG. 5

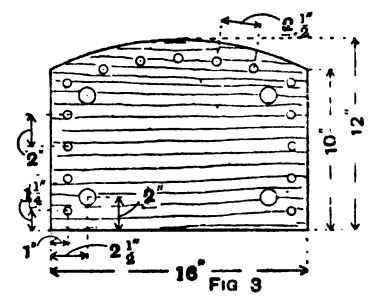


FIG 3

How to Make a Child's Chair.

the shape shown at Fig. 4; through these are bored five holes, four holes ¾ in. diameter, and one hole ¾ in. diameter, at distances shown on Fig. 4, starting from the front part of the arm into which the spindles fit. The top for the back is cut from 1½-in. wood to the shape and measurements shown at Fig. 5, and has holes bored halfway through to receive the back spindles, of which seven are required, 20 in. long, ¾ in. diameter, and tapered at the ends to fit into ½-in. holes. For the legs four pieces are required, 15½ in. long, 1 in. diameter, and tapered a little smaller at the top to fit in the holes made for them in the seat, which should be ¾ in. diameter. Fitted in the sides of the legs are two spindles, 10½ in. long and ¾ in. diameter in the centre, tapered at each end to ½ in. diameter; into these is fitted across a spindle 15 in. long and ¾ in. diameter. Before fitting the legs into the seat, fix the spindle into the legs, and then the legs into the seat; the legs are 14 in. long when trimmed flush with the seat; also trim the back and arm spindles flush. The arm-rests must be fitted on before the top of the back, so as to allow two of the back spindles to pass through the ends of the arm-rests. Then fit on the top of the back, and the chair is ready for decoration by paint or enamel. The measurements could be altered so as to make the chair suitable for an adult.

Cleaning Sheet Brass after Annealing.—Large sheets of brass should be annealed in a properly constructed muffle or furnace; small pieces may be done in an open fire of cinders or small coke, not too hot. Heat the plates to a dull red heat in the dark, and leave to cool off. They require careful watching, or they will burn. Some brass plates, after being rolled, annealed, and washed in sulphuric acid and water, have a red scale left on them. The scale can only be got rid of by grinding on a large stone, or otherwise by the use of pumice-stone and water, followed by dressing off with Tam-o'-Shanter stone. For cleaning up after firing, try a solution of about 1 part of nitric acid in 6 parts of water, slightly heating the brass before plunging it in, leaving for a minute or two, then brushing with a stiff worn-out brush, and finally washing in clean water and drying in hot sawdust. The solution may be bottled and used over again, adding a little fresh acid from time to time.

Strength of Sheet Iron Water Tanks.—Rectangular tanks are tested as follows: ⅛ in., 10 lb.; ¼ in., 5 lb. per square inch. The corresponding values for cylindrical tanks are 40 lb. and 25 lb. per square inch. The cylindrical shape is almost invariably used when the pressure exceeds about 12 lb. per square inch. The resisting powers of all tanks that are not spherical or cylindrical are increased by the use of internal stay-rods.

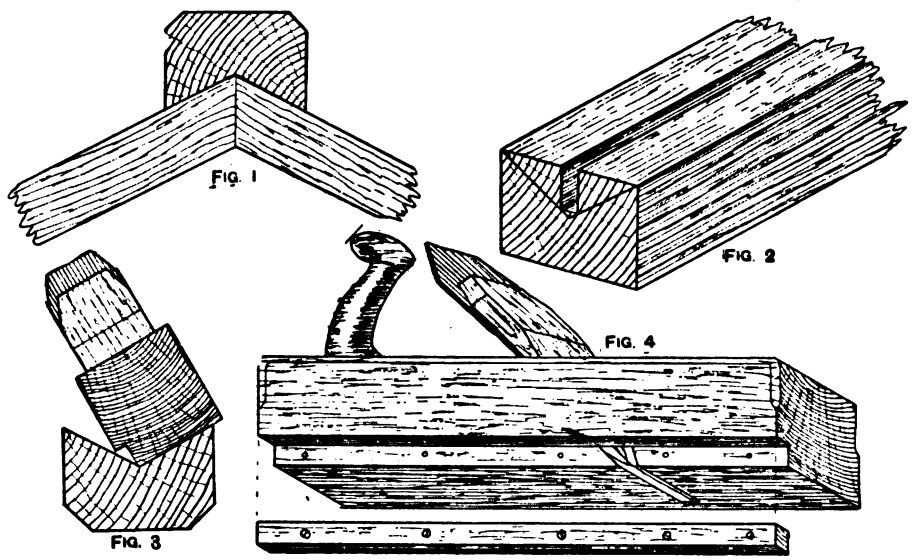
Photographic Mountants.—The best of all photographic mountants is starch. Place a teaspoonful of crushed starch in a teacup and mix into a thin cream with cold water, then, whilst stirring, add boiling water till the starch thickens. Allow to cool, remove the skin from the top, and the starch is ready for use. When more than two days old it does not answer well. The following have also been recommended, and will keep a considerable time. No. 1.—Dissolve 1 oz. of white dextrine in 3 oz. of water, add 1 oz. of powdered starch, and strain; then warm until the solution becomes clear. Now add about 40 gr. of white sugar and about half a dram of a 10 per cent. solution of carbolic acid. No. 2.—Soak 1 oz. of gelatine in 4 oz. of water for an hour or so, then add ½ oz. of chloral hydrate, keeping the solution hot during this addition. Or a good plan is to dissolve the chloral hydrate in a portion of the water, and then add whilst hot. A few drops of a saturated solution of carbonate of soda should be added to render it faintly alkaline. This mountant is extremely adhesive and does not penetrate the paper, so that it is specially suitable for mounting glazed prints, which lose some of their brilliancy when the mountant is very wet.

Chemical Fire Engine.—The chemical fire engine is fitted with two tanks, one of which contains a solution of bicarbonate of soda and the other sulphuric acid. By allowing the acid to flow into the bicarbonate, carbonic acid is evolved, and the pressure induced forces the liquid through the hose pipe. When the liquids are mixed there is present a solution containing sulphate of soda holding carbonic acid in solution, and this has been found very effectual in putting out fires.

Preparing Moonlight Scenes for Diorama.—The high lights should be cut with a sharp knife, each cut being horizontal, and from 1 in. to 3 in. in length. Take care the cuts do not run into each other. The path of the moonlight across the water should be cut thickly and close, especially at the horizon, getting broader as the bottom of the picture is reached. A few cuts to represent ripples about the other part of the water will give a nice effect. A good light must be placed behind the picture, the light in front being very dim. For a small subject there is no necessity to cover the cuts with gauze; the movement of the painting as it travels along will give the shimmering effect.

Lens for All-round Photographic Work, etc.—For all-round work with a whole-plate camera, procure a rapid rectilinear of about 9½-in. focus by a good maker, such as Ross, Dallmeyer, Wray, or Taylor. The components of the lens should be of different foci, so that varying sized plates may be used, or different angles included. A lens of this kind may be made to do duty for a variety of purposes. For example, quoting from one maker's list, a lens of 9½-in. focus covering a whole plate at full aperture (*f*/6·3) will, when stopped down to *f*/11·3, cover a 10-in. by 8-in., or to *f*/22·6 a 12-in. by 10-in. The lens is composed of two compound lenses of 14 in. and 19½ in., covering plates, when used at *f*/12·5, of 10 in. by 8 in. and 13 in. by 11 in. respectively. The lens is listed at £16 10s. Thus, for architectural work, where a doublet is most needed, the lens might be used in its entirety, and on a 12-in. by 10-in. plate if in a confined situation. When portraits or landscapes where good perspective is an important consideration are attempted, the single components or a smaller plate must be used. It must be borne in mind that the value of the stops varies with the lens. For example, a stop about 1 in. diameter, which, when used with the lens entire, was valued at *f*/8, would become, approximately, *f*/22 and *f*/32 when used with the single lenses. Lancaster's combination rectigraph is on the same principle, and costs £2 10s.

Hollowing the Underside of Ridge Roll.—To hollow the underside of a ledge for covering the joint of a roof as shown in the accompanying sketch (Fig. 1),



How to Hollow the Underside of Ridge Roll.

the end of the piece of wood should be marked out and a small plough groove made, as shown at Fig. 2. The greater part of the superfluous material can then be cut away with a mallet and chisel. The surfaces can be finished with a broad rebate plane or, better still, by a jack plane (or panel plane) with a side slip, which takes off as shown at Figs. 3 and 4.

Obtaining Smooth Surface on Glass Balls.—To get a perfectly smooth surface on glass balls direct from the moulds, remove the outer hard skin of glass by revolving the balls with a little fine emery powder and water; after that they will grind themselves smooth. If a polished surface is required, the balls will have to be revolved with plenty of dry rouge, colcothar, putty powder, or other rather soft polishing powder quite free from grit.

Darkening Light Brown Leather Shoes.—To darken a pair of light tan shoes, give them a couple of coats of Propert's dark stain, and afterwards polish with the darkest brown cream that can be obtained. If the leather has not been creamed before, a couple of coats of the darkest brown shade of Dolly dye might be applied: cream takes well afterwards.

Enlarging a Quantity of Small Photographs.—To enlarge to cabinet size, with as little expense as possible, a considerable number of small photographs, stamp size, the prints must be copied the same size, and the negatives thus obtained enlarged upon bromide paper. If the prints are unmounted, proceed as follows:—Soak them in water, and, while they are still in the water, get as many as can be accommodated (probably about sixteen) on to a quarter-plate piece of clean glass that is free from scratches and bubbles, and squeeze well into contact by placing a sheet of blotting-paper over the back and driving out air bubbles. The prints must be placed face downwards on the glass. Put the glass in a printing-frame and hang it flat against a wall in a full light. Extend the camera to twice the focus of the lens and place it at the same distance from the printing-frame, measuring both ways from the stops. Having focussed very accurately in the centre, stop down until the outermost pictures are sharp. Use slow plates and give two exposures, one double the other. These negatives should be enlarged on to bromide paper 24 in. by 18 in., which will give 6 in. to each picture. Pictures as nearly the same as possible in tone should be chosen for enlarging together. Each picture could, of course, be enlarged from a separate negative, but the expenditure of time and money would be considerable. When developing a sheet of this size the developer can be applied with a large pad of cotton-wool or a flat soft brush, first wetting the print with water to slow development.

Height of Domestic Hot-water Expansion Pipe.—The expansion of water in these apparatus never exceeds 1 in 30; that is, the top water line in the apparatus never stands higher than the cold-water line in the cistern which feeds it, more than 1 ft. for each 30 ft. vertical height to which the apparatus extends. It is seldom that an apparatus of this kind exceeds 60 ft. vertical height, and at this height it is seldom that the water is anywhere near boiling point in every part of the apparatus (except the cold supply pipe), as the 1 in 30 rule requires it to be. The common practice, therefore, is to let the expansion pipe extend at least 2 ft. above the cold-water line in houses of moderate size, and 3 ft. or more in tall houses. This is easily remembered, quite safe, and applies to all systems of apparatus. The quantity of water held in the apparatus makes no theoretical difference. In practice, it may mean that the large quantity does not get so hot.

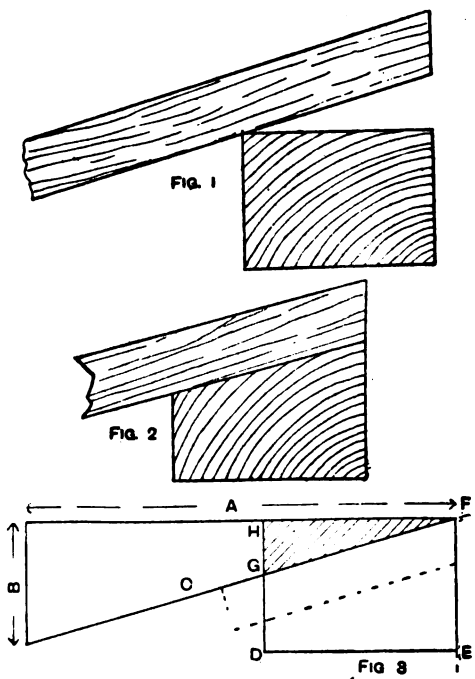
Making Liquid Malt Extract.—To prepare a small quantity of liquid malt extract, cover the malt with water and heat to a temperature of 180° F. for an hour, then press out the extract from the grains. The addition of a small quantity of spirit of wine will prevent it becoming musty. On a large scale, the malt is thoroughly exhausted with sufficient water, and the liquid concentrated in a vacuum pan at a temperature of about 130° F. A steam heat (*i.e.* 212° F.) spoils the malt extract to some extent.

Oiling Watches and Clocks.—In choosing the oil to be used for watches and clocks, it should be remembered that a watch will generally go from two to three years before the oil dries up. A clock, as a rule, will go from three to five years, according to the situation of the clock and the fit of its case. Dried-up oil must always be removed before applying fresh; thus a watch requires cleaning every two or three years. Watches require a very thin light oil, clocks a heavier oil; clock oil would soon stop a watch, and watch oil would soon run away from the pivots of a clock.

Dimensions of Canoe to Carry One Person.—A canvas canoe of the following dimensions would carry one person of ordinary weight on about 4½in. draught, but by adding 2ft. to her length she would be considerably easier to propel:—Length over all, 10 ft. 6 in.; length on load water-line, 10 ft.; beam at gunwale, 25 in.; beam on load water-line, 27 in.; draught amidships, 4½ in.; draught at ends, 3½ in.; freeboard amidships, 4 in.; freeboard at ends, 7 in.; the greatest beam being on load water-line, and at a distance of 6 ft. from the bow. Oak, rock elm, pine, or larch will be suitable for the canoe.

Determining Contents of Cylindrical Tank.—First determine the contents of the tank in cubic feet. To do this, square the diameter in feet and multiply by ·7854; then multiply by the length in feet. Thus the contents of a circular tank 7 ft. in diameter by 18 ft. high will be 7 × 7 × ·7854 × 18 = 38·5 × 18 = 693 cub. ft. (approx.). Then 6·23 gal. of water occupy 1 cub. ft., so that the contents of the tank will be about 693 × 6·23 = 4,317 gal. A quicker way is to reckon that a tank 1 ft. in diameter and 1 ft. high will hold 4·9 gal. Then, since the capacity will vary with the square of the diameter and with the length of the tank, it will be about 4·9 × 7 × 7 × 18 = 4,320 gal.

Shaping the Top Rail of Greenhouse.—To determine the bevel or slant of the top cross-bar so that the

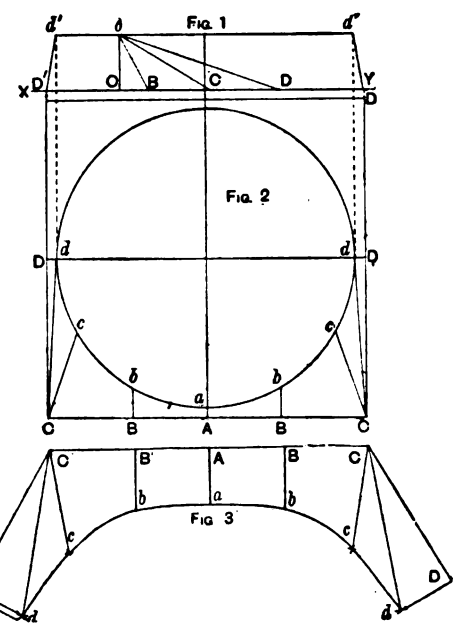


Shaping the Top Rail of Greenhouse.

piece shown in Fig. 1 shall be fitted as in Fig. 2, draw (Fig. 3) to scale as shown. Along a horizontal line mark off the span of the greenhouse to 1 in. to the foot say, as indicated by A; then draw the vertical line shown at B, and mark off the amount of fall (that is the difference between the height of the front and back) to the same scale. Then the line C represents the correct fall. The end view of the rail can now be marked out full size as shown at D E F, and the triangular piece scored shows the amount of material to be taken off. A gauge may be set to the distance G H, and the wood marked by it; or a bevel can be set as indicated by the dotted lines, and the wood planed to suit it in the ordinary manner.

How to Gild Piano Fronts.—Artistic designs similar to work seen on piano panels are usually put on by transfer process after the panels have been bodied up: the subsequent polishing and finishing out will give an appearance of inlaid brass. In exceptional cases the panels are finished out first, the decorative design is carefully cut in with oil gold size, the gold applied, and afterwards outlined and shaded with sienna. Occasionally engraved patterns may be seen, but in the majority of cases only the outlined portions are gilt, the lines being very fine. Piano fronts are often finished with a marqueterie centre, with gold incised borders and corners. To gild these, it is usual to finish polishing the panels before passing on to the gilder, who will brush into the incisions several coats of parchment size and whiting tinted with orange or lemon chrome; this mixture must be spread evenly, as it sets very quickly. Clean off the surplus with a slightly wet rag stretched over a flat cork rubber; avoid rubbing any more in the channels. When a solid basis has been thus formed, oil gold size is applied by means of a very fine hog-hair brush; it is spread evenly. When nearly dry, it is ready for the gold leaf, which is cut up into narrow strips on a special cushion; this is laid over the lines, and well skewed in by a tuft of wadding and camel-hair brush. Clean off all surplus as before, using a piece of cloth slightly damp with turps.

Pattern for Square Aquarium Top.—To make a perforated square zinc top for an aquarium, that could be taken off and put on as required, commence by drawing a plan and elevation (Figs. 1 and 2) to the required size. Divide the semicircle *d d* (Fig. 2) into six equal parts, and draw lines at right angles to C C to pass through the division points *b b*; also join the division point *c* to C and *d* to C. From any point along X Y erect the perpendicular O *o*, and from O mark off lengths corresponding to *b* B, *c* C, C *d* (Fig. 2); join these points to *o*, and the lengths found, B *o*, C *c*, D *o*, will be the true slants of the lines *b* B, *c* C, C *d* (Fig. 2). To work the pattern, draw a straight line equal in length to C C (Fig. 2); mark upon this line a centre point A (Fig. 3),



Pattern for Aquarium Top.

and mark on either side of A divisions corresponding to A B (Fig. 2). From A, B, B (Fig. 3) draw lines at right angles to C C, and mark on these lines from the point A, a length equal to D' *d'* (Fig. 1), and from B, B lengths equal to *o* B (Fig. 1). Next use C as centre, and with radius C *o* (Fig. 1) draw an arc; with *b c* (Fig. 2) as radius and *b* (Fig. 3) as centre, cut the arc first drawn to obtain the point *c*; again use C as centre on both sides of the pattern, and with radius *o* D (Fig. 1) draw an arc; with the division length *c d* (Fig. 2) cut the arc so as to obtain the point *d*. Now take the length C D (Fig. 2) as radius, and again using C (Fig. 3) as centre, draw an arc; with D' *d'* (Fig. 1) as radius and *d* on the pattern as centre, cut the arc first drawn. Join the intersecting arcs *d* D by a straight line, and also join D C. Draw a curve through the intersecting arcs *d*, *c*, *b*, *a*, *b*, *c*, *d*, to complete the half pattern with seams placed in the centre of the sides at D *d*, D *d*. When making the top, bend the corners C C upon any sharp-edged tools until the sides form a right angle with the end; the semicircle forming the half top can be brought to shape by pressing the perforation to a circular shape with the thumb. If the two halves are to be grooved together, an equal allowance for the groove will be necessary on each side of the pattern; if soldering is adopted, then one lap, as shown, will do.

Grease for Under-carriage of Victoria.—The best lubricant to use on the perch bolt and felloe pieces when putting together the under-carriage of a victoria is made by melting some tallow, then mixing with it sufficient axle oil so that it will be quite soft when cold, and about two small packets of powdered blacklead to 1lb. of tallow and oil. The under-carriage, if the vehicle is in constant use, should be taken out each time the trap is oiled, which is about every three months.

Removing Brass Collars from Glass Ware.—If it is wished to preserve the collars, allow them to stand for some time in dilute hydrochloric acid, which will dissolve out the plaster-of-Paris. If the collars are not required, place them in strong nitric acid, which will dissolve the brass. Another method is to make file marks just above the collars, heat a piece of glass rod or thick iron wire in the blowpipe flame, and place it on the file marks. Often a crack will go right round at once; if not, the crack can usually be obtained after two or three heatings in this way.

Tightening up Floor Boards without Using a "Dog."—Floor boards can be tightened up without the aid of a floor dog by the method shown at Fig. 1. The board next the wall should be well secured to the joists, and then three or four boards can be laid down and tightened up by means of wedges, as shown. The following is the method of procedure:—Place a piece

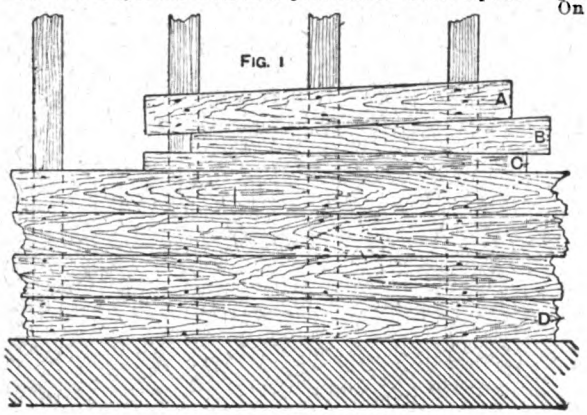


FIG. 2

Tightening-up Floor Boards.

of quartering about 2in. by 3in. next to the floor board, as at C. Cut a wedge, and place it as at B; then nail down a piece of batten to the joists, as at A (both this and the wedge can be cut out of odd pieces of floor board). The wedge B should be driven with a large hammer or axe until the joints of the board are quite close. Use prepared grooved and tongued boards, a section of which is shown at Fig. 2, to prevent dust and draught passing through the joints of the boards after they have shrunk.

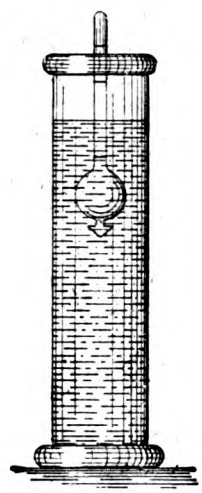
Transferring Drawings to Linen.—Transfer drawings of flowers, etc., are made with some composition on tissue or tracing paper from stencil plates cut to suit the particular patterns. The composition is a material consisting of resin and colouring matter (common red sealing wax would do). This is powdered and sprinkled over the stencil while it is lying on the paper. On running a hot iron over the stencil plate the design is left on the paper. To transfer to linen, place the paper on the linen and run a hot iron over the back of the paper.

Blackening Brass Buttons.—To make shiny brass buttons black, immerse them in a strong solution of copper nitrate or sulphate. Then heat them on a hot plate or carefully in the flame of a Bunsen burner till they are black. Well swill them in hot water, and dry out in sawdust; polish with a blacklead brush and lacquer.

Bevelling Plate Glass.—To obtain a bevel edge on plate glass, either circular revolving tables or fixed ones may be used. The table for grinding is of thick cast iron, and is fed with sand and water; the smoothing table is of glass with emery of different degrees of fineness and water, and the polishing tables are of wood covered with leather or felt and sprinkled with rouge of increasing degrees of fineness. If revolving tables are used, the glass plate must be fixed in a frame capable of being adjusted at any required angle, and the frame must be brought down until the edge of the glass just touches the table. As the grinding proceeds, the glass is brought lower until the bevel is fully formed. After bevelling all the edges the glass must be transferred to the smoothing table, and finally polished on the wood table. If fixed tables are used, the frame containing the glass plate will have to travel perfectly true backwards and forwards over the tables.

Taking Apart a Geneva Lever Watch.—In taking a Geneva lever watch apart, first remove it from its case; then lever off the hands, remove the dial, and take off the motion wheels underneath it. Next remove the central set-hand arbor by knocking it out with a light tap. It is friction-tight only in both the cannon pinion and the centre wheel. Then let down the mainspring by a key on the winding square while holding the click back. Take out the balance, pallets, 'scape wheel, train wheels, centre wheel, and barrel in the order named.

Particulars of Salinometers.—There are two kinds, one giving the percentage of common salt in the solution, the other used by marine engineers as a guide to the point at which to blow off. Salinometers are made either of glass or brass in the form shown in the adjoining figure. On the first kind each mark represents 1 per cent. of



Salinometer.

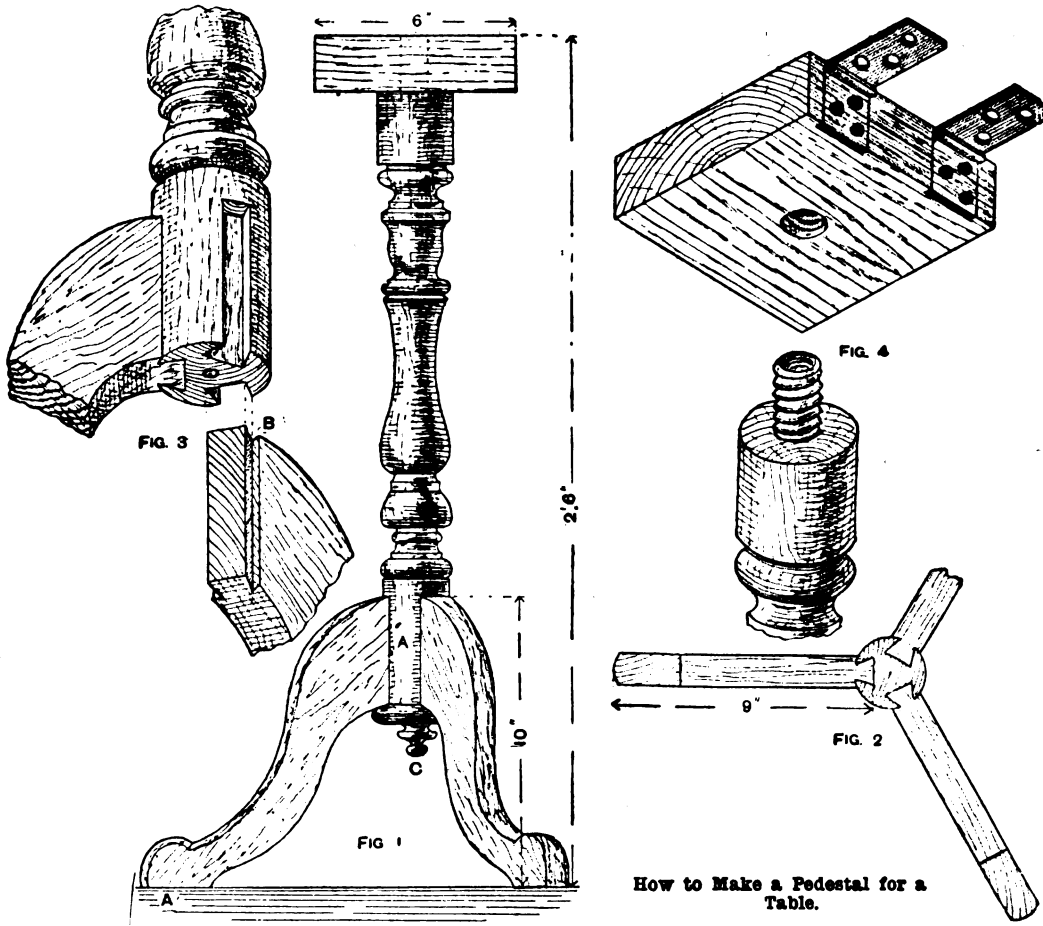
common salt; on the second kind there are only three or four marks, one being marked "blow." To use the instrument, float the salinometer in a little of the water; the mark on the stem corresponding with the surface of the water indicates the density of the liquid.

Mixing Lime Concrete.—For ordinary foundations, with no great or concentrated loads, the following proportions may be adopted: Bricks, broken to pass through a 2-in. ring, 4½ parts; clean, sharp sand, 2½ parts; ground lias lime, 1 part. If the bricks are broken to pass through a 1½-in. ring, then 5 parts to 2 parts sand and 1 part lime may be used. The materials should be accurately measured in gauge boxes, turned over twice or thrice, dry, so as to be intimately mixed before being wetted, water applied by means of a watering can with a rose on the spout, materials again turned over twice, deposited in the required spot in layers about 12in. thick, carefully rammed, and left to set. It is important not to disturb the mass after it has begun to set.

Cleaning Velvet-pile Table Cover.—To clean a velvet-pile table cover, first remove all dust by hanging up the table cover and carefully beating it; then treat it several times with benzine, pressing each time so as to remove all the dirty liquid; then hang it in the open air to dry. Of course, this dry cleaning should be done in a room in which there is neither fire nor artificial light. After thoroughly drying, if the table cover is not sufficiently clean, lay it on a table and carefully sponge it all over with a mixture of equal quantities of methylated spirit and water. Do not wet it more than is absolutely necessary, and immediately dry it by pressing dry, clean linen cloths upon it. Again dry the cover, and brush it carefully with a moderately stiff brush to raise the pile

Heat-resisting Covering for Steam Boilers.—Hair, cotton, fibres of organic origin, and feathers are the best materials, though fine sawdust and cork powder have been used. Clay with fibres, and fibres with cow-dung have also been employed. The materials should first be powdered, and afterwards applied in the form of washes to the surface, which must be quite free from grease. A covering of canvas, wire netting, hoop iron, boards, etc., should be placed outside.

Making a Pedestal for a Table.—The following illustrations give a design for a pedestal for a walnut table top; the table is 2 ft. diameter and ½ in. thick. Fig. 1 shows the elevation and Fig. 2 the greater part of the plan, looking up. The column should be turned out of stuff about 3 in. square. The upper part of the column can be finished with a screw, as shown at Fig. 4, for fastening on the block. The legs should be



How to Make a Pedestal for a Table.

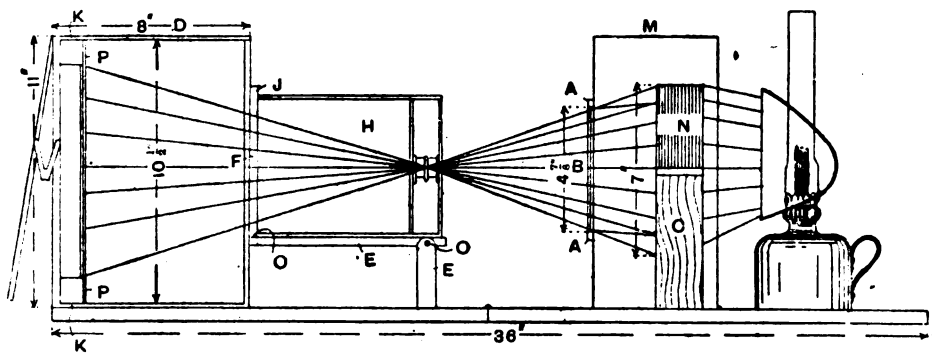
cut out of material with the grain running in the direction of A A (Fig. 1). A simple method of connecting the legs to the column is by means of dovetail housing, shown at Fig. 2. A conventional view of this joint is shown at Fig. 3. It should be noticed that the shoulders require to be undercut (see B, Fig. 3). The "drop" shown at C (Fig. 1) is a separate piece of turning with a dowel attached so that it can be fastened to the bottom of the column. The top may be hinged to the block by means of two flaps, as indicated at Fig. 4.

Method of Burning Limestone.—No very great improvements in the method of burning mountain limestone have been made for several years, but there are kilns, such as the Hofmann kiln, and calciners which are great improvements on the old forms of kiln. The Hofmann kilns are very large and circular or oval surrounding a chimney stack; they can be divided into twelve or more compartments, each one of which has a door for charging purposes, an opening connecting it with the chimney and covered with a damper, and holes in the roof for stoking purposes. In starting the kiln all the compartments but one are filled with limestone loosely piled and the doors made up. Fires are made in the empty compartment, and the dampers are all closed with the exception of that in the farthest chamber, so that the flames and hot air have to travel all round the kiln before they escape to the chimney. As the coal burns away slack is fed through the holes in the roof, and when the limestone is fully burnt in the first compartment the damper in the empty compartment is thrown open and the other closed, so that the empty compartment becomes the last in the series, and the first compartment begins to cool down. The coal is now fed through the roof of the second compartment, and this procedure goes on right round the kiln. The empty compartment is charged as soon as it is cool enough to enter; the first compartment is next emptied and refilled, and so on, emptying and refilling going on all the time. The calciner is made in the usual form of circular kiln, but it has a cone-shaped structure at the bottom, and there are openings all round the circumference of the furnace above the floor level. The limestone and slack are fed in at the top, and as the coal burns away and the limestone contracts during its conversion into lime, it gradually descends, but is prevented settling at the bottom of the furnace by the cone-shaped structure, which directs the material towards the walls of the furnace, and it falls out through the openings above mentioned.

How to Get Rid of Mites in Furniture.—Use ordinary furniture polish on the wood of the furniture, and place a saucer full of strong ammonia below the so a and chairs from time to time. As a rule, a dry room is best for furniture, and therefore a fire should be lighted often. It will prevent the damp settling upon the furniture and carpets, and will tend to keep out insects. Washing the floors with a carbolic soap will also be found of great value.

Varnishing a Van in the Natural Wood.—Where the grain is to show out plain it is not customary to stain the wood; staining blurs the natural grain, on account of one part absorbing more stain than another. The method usually adopted for vans, etc., is as follows: After the body is got up clean, and glasspaper marks across the panels have been removed, apply a good coat of pale gold size, to which about a tablespoonful of linseed oil to a pint of size has been added; let this stand a day or two, then lightly rub over with fine sand or glasspaper to take off the grain which will rise; then give another coat of gold size only. When hard, sandpaper off as before, and apply a coat of hard drying carriage varnish. Let this stand for a couple of days, and then flat down with ground pumice-stone and water, being careful to wash every particle of dust from the corners; then give a coat (or two coats if necessary) of best carriage varnish.

Enlarging with Fixed Focus Hand Camera.—The accompanying sketch shows an arrangement for making either enlarged negatives or prints. In the bottom of a lidless box M cut an opening 4¼ in. by 3¼ in.; fit grooves A A top and bottom, to carry the negative B (the box is standing on end). Make a box D of the size and shape shown (see also ground plan), having an opening at F a little smaller than the hand camera H, and with a close-fitting fillet run round it on the outer side at J, forming a recess, into which the back of the camera fits, and is supported on the bracket E. The bracket is either detachable or hinged at O O. At the rear of the box is fastened another fillet P, at exactly 13 in. from the lens stops. Cut a slot right down one side rather greater in width than the thickness of a whole-plate printing frame. The frame should now be built up at the same side flush with the outside of the box, and a further piece screwed on, projecting ¼ in. each way beyond the opening, and fitting close to exclude light. Now insert the frame, facing the lens, and screw another fillet behind it, so that it just runs easily between them. The frame is assumed to measure 10½ in. by 8½ in. Next cut from a block of wood C a recess to form a bed for the condenser N, the centre of which must be exactly opposite the centre of the negative, the lens, and the printing frame. A lid may be hinged to D. The camera and other loose parts may then be stored inside. Now construct a board 36 in. by 8 in., hinged in the centre. Put two screws in the extreme end; these, by engaging with holes in D, ensure its being always in the same place. Now place the other parts roughly in position. Fix, with drawing-pins at the corners, the sheet of ground glass, rough side outwards, in the printing frame, and insert it in D. Having put the negative B in position, focus very accurately by moving the box to and fro. The condenser and light are next manipulated until the corners of the negative are illuminated and an evenly lighted screen is obtained. Then screw the block in position in M, and fit the points for the other parts as before. Instead of using a condenser, a piece of magnesium wire may be burnt behind the negative, the light being waved about, so that the negative may be evenly illuminated. In this case a sheet of ground glass should be placed a few inches behind the negative. To use the apparatus it will merely be necessary to insert the negative, then place in the printing frame a sheet of clear glass, free from bubbles or scratches, and of the same thickness as the ground glass mentioned above. Place upon this, face downwards or outwards, a sheet of bromide paper, and, having turned the light down very low, insert through K. If preferred, a sheet of cardboard, which can be slid out after placing the frame in position, may be made to run in front of the printing frame. The above dimensions are worked out on the assumption that the lens is of 5-in. focus.



Enlarging with Fixed Focus Hand Camera.

Using Gold Bronze.—To apply gold bronze to furniture in paint form, coat the furniture with paint, japan, spirit varnish, or anything that will prevent suction; then coat where the bronze is wanted with gold size or quick-drying varnish. When this is nearly dry, dust on the powder with a camel-hair brush or soft new chamois leather. As bronze is susceptible to atmospheric influences, it should be coated with a thin, even coat of varnish—clear spirit or oil varnish will do. Work thus treated will have a common brassy appearance, by no means equal to gilding. When gold leaf is too expensive, use Dutch metal, which can be purchased at from 2d. to 6d. per book.

Moulding and Vulcanising Indiarubber.—The tools required would be a small rotary cutter, a sheet-iron box with sliding front and chimney at top, an iron tray, two large ring gas burners, knives or spatulas, and iron moulds shaped like the blocks required. The rubber may be cut in the rotary machine, mixed with powdered sulphur, placed on the iron tray in the sheet-iron box, and heated by the burners. A thermometer hung in the box very close to the iron tray will show the temperature, which must not rise above 300° F. When the rubber is softened, the moulds may be heated in the box, the rubber put in, and the tops of the moulds forced down so as to compress the rubber; the moulds may then be allowed to become cold, and the blocks withdrawn. Before pressing in the rubber, rub powdered French chalk over the insides of the moulds.

Obliterating an Engraved Crest on a Silver Jug.—To remove an engraved crest from a small silver jug, (1) file out the work with a fine flat file if the surface of the jug is of a full or rounded nature, and with a riffler or small bent file if hollow. Finish with snakestone or Tam-o'-Shanter hone, and polish with rottenstone and oil. Send it to be electro-gilded and scratch-brushed on the inside, with a light coating of silver on the outside, and have the outside burnished and "handed up." The jug will thus look equal to new. Before sending to plate, look well over for possible dents. (2) Fill up the cuts with silver solder—same colour as near as possible to the silver—dress off, and finish as No. 1. (3) Cut out a shield from sheet silver (No. 6 to 9 gauge, S.M.G.) either round, oval, or of an heraldic shape, hard solder neatly, and finish as No. 1.

Shaping Soap into Bars and Tablets.—The soap is made by boiling fats and caustic soda in large pans, from which it is run through channels over the "frames"; the latter are large rectangular moulds built up of iron plates bolted together. When the soap is cold the plates are unbolted and removed, revealing the blocks of soap. A frame with horizontal wires is run through the blocks, cutting them into slabs. The slabs are pushed against other wires, cutting them into bars. Tablet soaps are pressed from the bars or from ribbons. Toilet soaps are made by forcing bar soap against a cutter, which cuts it into thin slices; the slices are placed in a roller machine, from which it emerges in the form of extremely fine shavings. The shavings are partly dried on wire netting in a heated room and then placed in a press, from which the soap emerges as a bar with a square, round, oval, or other section. The bar is cut into pieces of equal thickness forming plain tablets, which are then pressed in a machine having dies with appropriate designs. In scented soaps the ribbons are gently heated with the scent, or the scent is added immediately after the soap is made for common qualities.

Calculating Heating Surface of Radiators.—For calculating the heating surfaces of radiators and pipes for schools, greenhouses, etc., the following notes are useful:—For brick buildings, for a temperature of 50° F., use 7 sq. ft. of heating surface for every 1,000 cub. ft. of space; for 55° F., use 9 sq. ft.; for 60° F., use 12 sq. ft.; for 65° F., use 15 sq. ft.; for 70° F., use 19 sq. ft. For lean-to glasshouses, for a temperature of 45° F., use 37 ft. of 4-in. pipe for every 1,000 cub. ft. of space; for 50° F., use 40 ft. of 4-in. pipe; for 55° F., use 45 ft. of 4-in. pipe; for 60° F., use 50 ft. of 4-in. pipe; for 65° F., use 55 ft. of 4-in. pipe; and for 70° F., use 60 ft. of 4-in. pipe. For span houses, add one-fifth.

How to Find the Mitre, etc., of Raking Cornice Moulding.—A (Fig. 1) shows the true section of the raking moulding. The five points have been taken in the

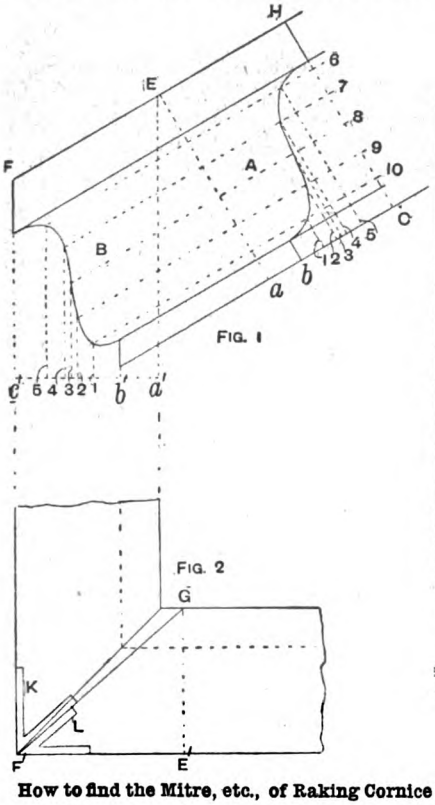


FIG. 1

FIG. 2

How to find the Mitre, etc., of Raking Cornice Moulding.

curve, and lines 6, 7, 8, 9, and 10 drawn through them. Then from these points perpendiculars are drawn to the bottom line—Nos. 1, 2, 3, 4, and 5; also C. From E draw the vertical line a' E, and at right angles to it $a'c'$. Now mark off the divisions a', b', 1, 2, 3, 4, 5, and c' as shown, making them correspond to a, b, etc. Next raise ordinates, making them intersect their respective raking line as shown. Through these points draw the curve, and complete the section of the level moulding. To obtain the mitre, project the plan as shown at Fig. 2; then take the distance E F (Fig. 1) and mark it off on the plan as shown at E' F'; project across to G, and join F' to G. Then the bevel for the mitre of the raking mould will be that shown at L, and that at K for the bevel mould.

Clock Escapements and Motive Power.—When a cheap clock, such as an American spring clock without a fusee, is first wound up, the motive power is very great, and when the same clock is nearly run down, the power has diminished to perhaps less than half. The effect of this with a recoil escapement (one in which the 'scape-wheel recoils at each beat) and a light pendulum is to make the clock go gradually slower as it runs down. With a heavy pendulum the error is less. A dead-beat escapement (one in which the 'scape-wheel remains perfectly still between each beat) has a very small error in the opposite direction, and the same clock fitted with it would gradually gain as it ran down. Therefore, to keep correct time, the escapement must not have much recoil, nor must it be perfectly "dead." A cheap clock with a light pendulum should have an escapement with a moderate recoil only, and a good clock with a heavy pendulum should have a nearly dead-beat escapement, or what is known as a "half dead," *i.e.* a dead-beat with a very slight amount of recoil on the resting surfaces, but hardly perceptible. The amount of recoil is determined by the shape of the pallets.

Making Marlboro' Easy Chair.—Figs. 1 and 2 show front and side views respectively of the framing. The total height is 4 ft.; width, 2 ft.; height of seat without cushion, 1 ft. 1 in.; height of arms from seat, 1 ft.; and width of seat from front to back, 1 ft. 8 in. The back legs, with the required sweep at the bottom, can be bought ready sawn at any chairmaker's. The seat frame is made from 2-in. by 1½-in. stuff; the rest of the frame from 1-in. stuff, with the exception of the front legs, which can be made Chippendale shape, square tapered, or turned in the lathe. Web the seat, back, and arm space for foundation for stuffing.

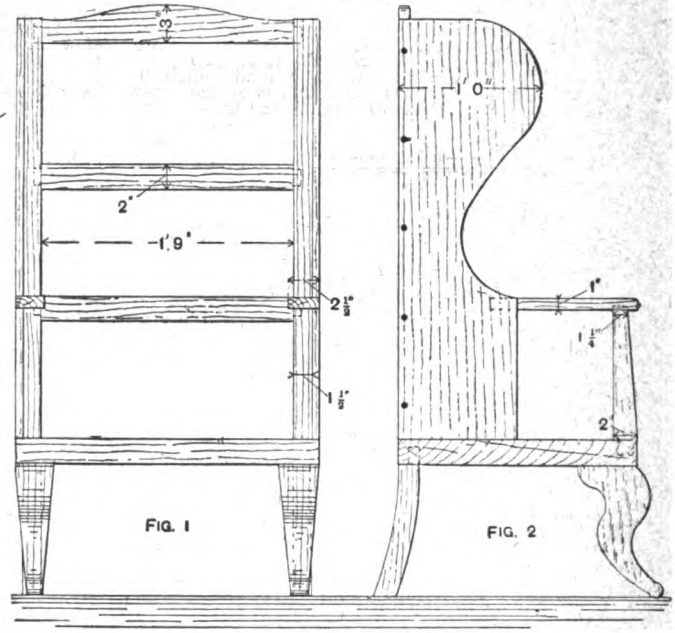


FIG. 1 FIG. 2

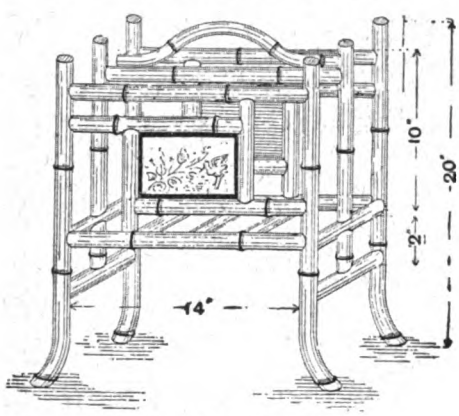
Marlboro' Easy Chair.

Make a loose cushion seat. Upholster in coarse canvas with hair or flocks, nailing the material on the outside edges; then cover with Gobelin tapestry or cretonne; cover the sides and back with the same material, sewn together at the edges and corded, or tack round a narrow coloured gimp.

Colouring Drawings.—The colours used in architectural and mechanical drawings vary according to circumstances. Some draughtsmen use a very pale sepia for York stone in elevation, pale Payne's grey for Portland or Bath stone, pale indigo with ink dots for granite, and darker tints of the same colours for the sections. This, it must be remembered, is chiefly in connection with London stock bricks. Architects, who ought as a body to have an eye for colour, are sometimes great offenders by using harsh and unnecessary colours on their drawings. An extreme case has been noted where a wrought-iron girder resting upon a cast-iron column standing on a stone base were all coloured bright Prussian blue. Blue in some form or other is much used by architects to represent stone, but it should be used very sparingly, so as to resemble the natural tint of the stone rather than the conventional representation. For a red sandstone, a pale tint of light red, Indian red, Venetian red, or burnt ochre might be used, depending upon the general elevation colour. For cement in any form in elevations, pale Indian ink or pale Payne's grey is generally used, with or without dots and markings. Windows may be coloured with black Indian ink, or washed Prussian blue, Prussian green, or Payne's grey, according to circumstances. A plain tint all over is the simplest, but a good artistic effect may be obtained with the exercise of a little skill.

Oleomargarine.—This is the softer portion of the purest and freshest beef suet from the ribs, rendered at 140° F. to 150° F., and the fat poured off clean and pressed at 95° F. The product is of a buttery consistency at ordinary temperature. The "oleo" oil, as it is called, is the chief constituent in margarine, but a vegetable oil is also employed; sometimes this is cottonseed oil, at others earth-nut oil or sesame oil. The oleo oil is melted and, along with the vegetable oil, is run into the churns; the milk is first soured by the addition of acid, rennet, or sour milk, run over cooling coils, and then into the churn. The churns are kept slightly warm, and are worked so that the fat, casein, etc., may amalgamate. They are then emptied into tanks containing water cooled with ice, the masses of fat are removed, piled up to drain for some time, then worked and salted like butter.

Bamboo Newspaper Rack.—Four 1-in. and two ½-in. canes will be required; from the former four lengths should be bent or toed out and cut off 20 in. long. Four pieces, each 16 in. long, for the four rails should now be cut off from the 1-in. canes, chisel-pointed, mortised (or hollowed) with the rasp, and fitted in their places. Holes should then be bored in the legs to receive the dowels, and the two sides framed up. While these sides, or sections, are setting, the two ornamental fillings should be made from ½-in. cane.

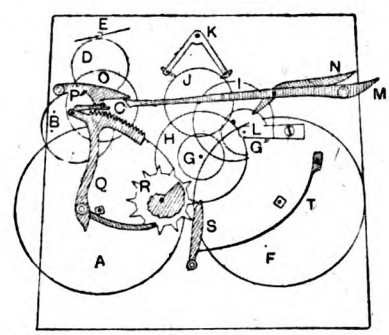


Bamboo Newspaper Rack.

Four pieces of 1-in. bamboo, each 9 in. long (1½ in. is allowed for fitting), should now be prepared to form the cross rails which are to join the two sections together. When the sections are set, holes should be bored to receive the dowels of the cross rails, and the whole joined together. The two uprights for the partition are fitted to the bottom cross rail, and the top cross rail and upright are half jointed where they cross. The rail which carries the handle is mortised and dowelled at each end and fastened into position with two round-headed screws. The handle is made from ½-in. cane bent as shown, and fastened to the centre rail with round-headed screws. The rails which form the division of the partition, as also the three cross rails forming the bottom, are made from ½-in. cane mortised at the ends and fixed into position with beading pins. A diagonal stay, not shown in the illustration, may be added to the central framework.

Photographing an Oil Painting—Whether the painting is under glass or not, it will probably be advisable to let it face the window. All reflections must be got rid of; sometimes slightly tilting the picture and swinging the back of the camera to compensate for it will be effectual. If possible, the centre of the lens should be opposite the centre of the painting. If the illumination in the camera is weak, focus upon finely grained glass, made by thickly coating a sheet of glass with negative varnish, and then rubbing down the surface with a little finely powdered resin on the ball of the finger; or the ordinary ground glass screen may be oiled. A firmly fixed copying camera, in which focussing is done by moving the back part, would be preferable to an ordinary camera. The lens should be one giving a flat field and the best possible definition. The stand must be rigid, and, as the exposure is prolonged, every precaution must be taken against vibration. The plates used must be colour-sensitive; Edwards' instantaneous isochromatic are very suitable. If the picture contains any blues or greens, a yellow screen must be used—a home-made substitute for which can be made by staining to a lemon yellow a fixed unexposed plate in a weak solution of picric acid. If the stain is too deep, the blues and greens will be rendered too dark. Pyro soda is a most satisfactory developer for the above-named plates. Use equal parts of each of the following solutions:—No. 1. Pyro, 25 gr.; sodium sulphite, ½ oz.; water, 5 oz. No. 2. Washing soda, 165 gr.; water, 5 oz. Add one drop per oz. of 10 per cent. potassium bromide solution. The negative should be thin and full of detail, with clear shadows.

Vienna Regulator Striking Clock.—In the accompanying figure the wheels between the plates are represented by plain circles to show their positions The gut lines are wound up on barrels, fitted with winding ratchets and clicks and click springs to prevent running back. The main wheels are driven by the barrels, and are mounted upon the barrel arbors. Around the pin wheel are arranged the lifting pins, which lift the gong hammer. The pallet wheel arbor carries the gathering pallet, which gathers up the rack teeth during striking. The snail, mounted upon the star wheel, determines the number of blows to be struck at each hour. This system of wheels is known as the rack striking work, and is used in a great many French clocks and in nearly all English grandfather and bracket clocks. The letter references are as follows:—A is the striking main wheel, B pin wheel, C pallet wheel, D warning wheel, E fly, F going main wheel, G minute wheels, H centre wheel, I third wheel, J 'scape wheel, K pallets, L minute wheel cock, M warning lever, N lifting



Vienna Regulator Striking Movement.

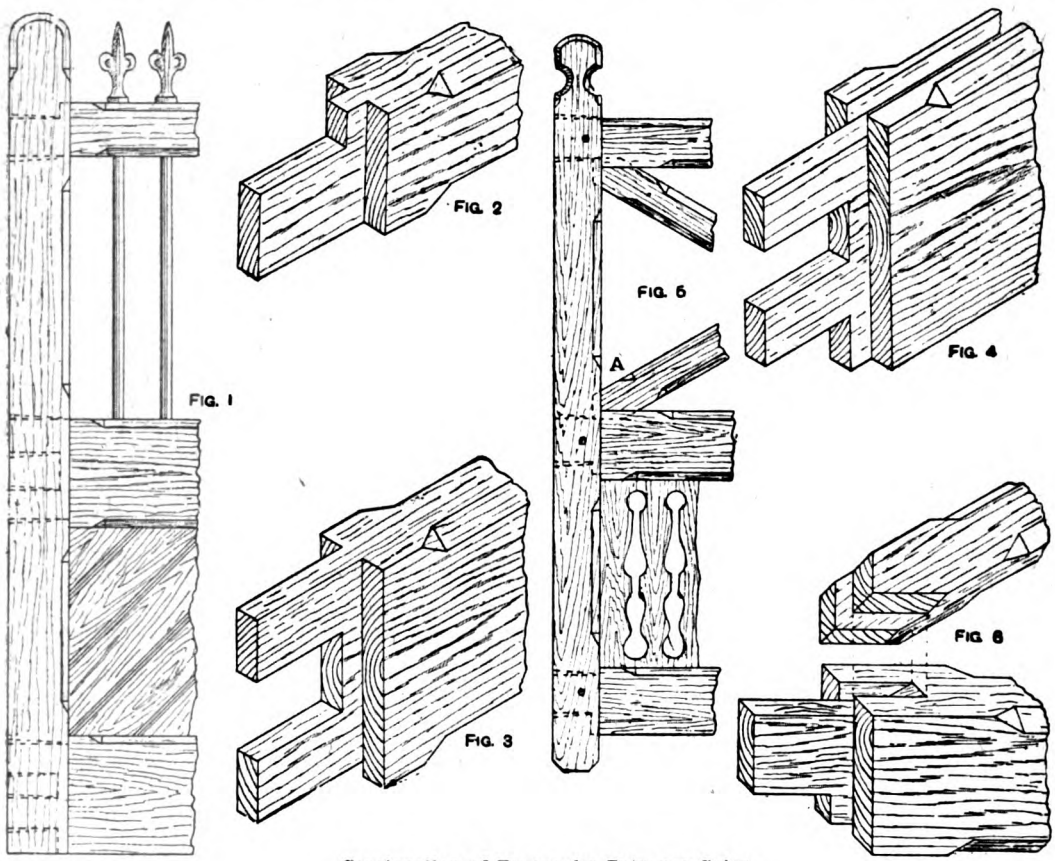
piece of warning lever, O rack hook, P gathering pallet, Q rack, R star wheel and snail, S flirt, and T the flirt spring.

How to Make Crystoleum Photographs.—A portrait should be chosen giving good gradation without very deep blacks. A pair of concave glasses in different sizes may be bought of any artists' colourman, and should be chosen to fit the picture. Mix some starch—as for ordinary mounting—to the consistency of thick treacle, free from lumps, and, having carefully cleaned the glasses and soaked the print and blotted off the surface moisture whilst lying face up on a sheet of glass, brush the starch well over the face of the print and over the concave side of the glass. Bring the two surfaces into contact and lay over the picture a thin sheet of blotting-paper; place the glass on a cushion and work the print thoroughly into contact with the glass by stroking with the convex side of a spoon in all directions from the centre until all air bubbles are expelled. When the print thus mounted is thoroughly dry, it is rendered as transparent as possible by rubbing away the paper, quite evenly, with fine glasspaper. When the film is nearly reached, cuttlefish powder may be applied with the finger or a tuft of wool. The print is next warmed carefully and rubbed over evenly with castor oil till it will take up no more, the surplus oil being wiped off and the print allowed to cool. Transparent oil colours are next laid on over the dress, hair, eyes, lips, etc. Flat tints merely are used, as the transparency supplies the modelling. The second glass is then attached, and on it the flesh tints are painted. The outlines must in all cases be carefully followed. The crystoleum may now be bound up by placing a piece of white cardboard at the back and binding the edges with black paper.

Stain and Varnish for Elm.—For indoor work, use a good quality spirit varnish; for outdoor work, use a good oak, copal, or carriage varnish. A wipe over with raw linseed oil will fetch out the figure, a reddish tinge being imparted by colouring the oil by adding a small quantity of alkanet root—2 oz. to 1 pt. Elm is a good wood for taking a walnut stain. Use a grain filler before applying any varnish or polish.

Two Boilers to One Hot-water Cylinder.—When a cylinder system apparatus is to be heated by two boilers, one boiler is generally connected to the cylinder in the usual way, and the pipes from the second boiler connected to the pipes of the first one, flow to flow and return to return. No fault can be found with this arrangement, which works well, whether either boiler is used separately or both are used together, and no stop-cocks are needed. However, a better arrangement is to connect the pipes from each boiler into the cylinder independently, instead of allowing the pipes to join outside the cylinder. In this case there is the possibility of more uniform results, and it seems a more correct way to do the work, although no fault can be found with the plan first explained.

Construction of Tenons for Entrance Gates.—The construction of tenons for gates, such as entrance gates to parks or lodges, is shown by portions of two typical



Construction of Tenons for Entrance Gates.

examples of gates (Figs. 1 and 5). The forms of the tenons, etc., are indicated by dotted lines. Figs. 2, 3, and 4 show isometric views to a larger scale of the tenons indicated at Fig. 1. Fig. 6 is an oblique projection of the joints at A (Fig. 5). When the rails are 3½ in. and under, they usually have tenons the whole width; but when over 3½ in. and up to 6 in. the tenons are diminished generally to 3 in. or 3½ in., having a haunch on one or both sides. When the rails are more than 6 in. wide, they frequently have two tenons in breadth as illustrated. The tenons are wedged into the mortises (see Figs. 1 and 5), and as an additional security they are occasionally pinned as indicated at Fig. 5.

How to Test Gold.—File a clean spot upon the metal to be tested, so that any gilding or outside colouring may be removed. Apply a small drop of pure nitric acid to this spot, and watch it closely. If the metal is brass, it will boil up a bright green immediately. If an imitation gold alloy, it may go black in a few seconds. If 9-ct. gold, it will turn a pale brown tint. If 15-ct. or over, it will remain unaltered, and the acid will stand upon it like water. Now press the tip of one finger hard upon it and wipe the finger again immediately. If 15-ct., the spot will turn a pale brown, as 9-ct. did before pressing with the finger. If 18-ct. or over, the acid will still stand upon it like water; 22-ct. can be told by its colour by an expert.

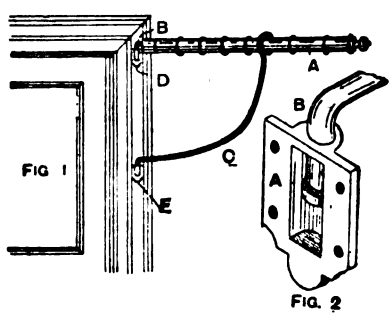
Dry-cleaning a Valencia Waistcoat.—Sprinkle a mixture of fuller's earth and magnesia over the waistcoat, then rub it in with a clean piece of flannel. With another piece of flannel apply benzine to the waistcoat, after which sprinkle some more of the powder and leave it for several minutes. Then brush off the powder and hang the waistcoat in a current of fresh air till the benzine has evaporated.

Staining White Wood Teak Colour.—Brush over the article some raw sienna ground in water, mixed in stale beer, and allow it to soak in. When nearly dry, wipe off the surplus with clean rag; this will give a yellowish undercoat. Now take some Vandyke brown ground in water, mix as before, and apply with a ragged piece of sponge, putting in the figure and varying by a tremulous motion of the hand, blending the colours and removing any harshness by going over the still moist colours with a badger softener or a clean soft sash tool. When quite dry, rub smooth with coarse rag or fine glasspaper, wipe over with raw linseed oil, then French polish or spirit varnish. A slight tinge of red in the polish will be an improvement.

Producing Crystals upon Wickerwork.—To produce crystals upon wickerwork, such as baskets, boil about 2 lb. of alum in 1 gal. of water, and, while still hot, pour this into a jar large enough to hold the baskets. When cool, some of the alum will crystallise out, leaving a saturated solution. Hang the basket in this solution, tying a string to the bottom and attaching a weight, so that the basket is suspended in the centre of the liquid. If allowed to remain several days, the basket will become covered with crystals, which will continue to grow in size if the jar be freely exposed to air.

Gilding Glass.—For gilding on glass, isinglass and distilled water are used; sometimes a little pure spirit of wine is added, but not necessarily, as the best results can be obtained with the distilled water and isinglass alone: these must be boiled for about five minutes and then passed through a filter or white blotting paper. Three grains of the best isinglass to 6 fluid oz. of distilled water make a good gilding strength. The liquid is then, by means of a broad camel-hair brush, floated upon the glass, which must be placed in a slanting position. While still wet the gold is laid on from a gilder's tip and cushion, and after it has been allowed to dry it is gently rubbed with a piece of fine wadding and the cracks or joints touched up. A second application of the gold leaf gives more solidity and makes a better job. It is now burnished again with the wadding and bathed with lukewarm water to bring up the burnish, drying with blotting paper. When thoroughly dry, burnish again, and then with a size brush dipped in water, with the heat increased each time, go over the gold again, thus giving it a third bath. It is then again rubbed and finally coated on the back with gilding size, which, when dry, is rubbed with the cotton. It is then ready for cutting into shape, which is done with a strip of wood cut like a chisel. When the letters have been cut they may be backed with japan gold size or ordinary black japan, or a mixture of the two. For small ornaments such as corners, paint directly on the gold with the japan, and when thoroughly dry, rub off the superfluous gold to leave the gold figures on the glass.

How to Make a Portière Rod.—The rod A (Fig. 1) is cut from a broomstick; at one end is fixed a fancy wood knob, at the other end a piece of brass pipe to act as a ferrule; into this end is screwed a round-headed brass

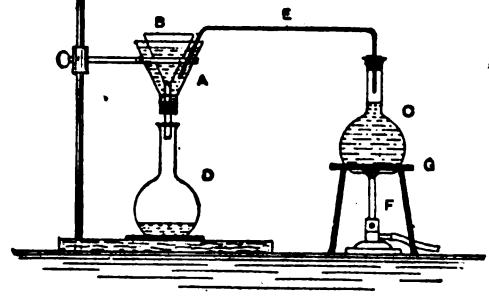


How to Make a Portière Rod.

screw bent to the shape shown (B, Figs. 1 and 2). Before screwing this into the end of the rod, it is fitted into a brass socket (see A, Fig. 2) originally made for door bolts to shoot in. The bracket C (Fig. 1) is made from ¼-in. iron and bent round the rod as shown, with one end fitted into a similar socket to that in which the rod fits. Brass curtain rings are put on the rod before it is fixed up. To fix it up, the sockets D and E (Fig. 1) are screwed to the door jamb. The rod is fixed inside the room, and when hung with drapery it serves to prevent a draught blowing on to anyone sitting at the right-hand of door when the door is open. The rod could be made of bamboo and with screw-eyes in place of sockets.

Polishing Marble.—Marble, such as is used for mantelpiece jambs, is polished in a variety of ways, the choice depending largely upon the nature and quality of the material, which vary greatly. The following method will answer satisfactorily for vein, statuary, Sicilian, St. Anne's, Bardilla, and most of the ordinary coloured marbles in general use. The wrought surface is rubbed with fine sharp sand and water, until all the marks of chisel or saw are removed and an even surface is produced. It is then "grounded"—that is, rubbed with grit stones of varying degrees of fineness commencing with the coarse or first grit, usually Robinhood stone; next the second grit, which is a little finer; finishing with snake stone or Water or Ayr stone. Particular care must be taken that in each process of gritting the marks or scratches of the preceding one are removed, so that when the surface is snaked no scratches whatever are visible. The gloss or natural polish is obtained by rubbing with a pad of felt sprinkled with putty powder (calcined tin) moistened with water. The chief factor in this method is persistent and attentive rubbing, and a good polish thus obtained will retain its lustre for years. For speed and cheapness chemicals are sometimes used for polishing, such as oxalic acid, hydrochloric acid (spirit of salts), and others, but their use is to be deprecated, as the polish soon vanishes and the face of the marble is in some measure destroyed. The polishing of marble adds greatly to its beauty, inasmuch as its delicate figuring and gradations of rich colouring are brought out and heightened as it were by the process, which gives marble its value as a decorative material. With regard to the appliances, for mouldings the grits are cut into small strips and shaped into hollows and rounds to fit the various members; and for the polishing boss, an old worsted stocking, tightly tied up in a wad, does admirably. For plain facework the grits are in flat pieces, and are used on edge, traversed over the face. The polishing block is a piece of wood from 16 in. to 18 in. long, and 4 in. wide, with a piece of felt on the underside fastened at each end.

Filtration of Oils by Heat.—Tow, such as brewers use for the filtration of malt liquor, answers well as a filtering medium for viscous fluids. The filtration is expedited by heat, and may be accomplished in the following simple manner. Two funnels are necessary. One funnel is placed inside the other, an indiarubber plug being on the neck of the inner funnel, around which the outer funnel fits. In order that the filtering liquid may be covered, the top of the inner funnel projects somewhat. The tow or paper is placed in the inner funnel, and the interspace contains water, which is kept hot by steam, which passes into it from a flask. The excess of water may be drawn off by means of a constant level syphon, or a strip of web-tape hanging over the outer funnel. The diagram is thus explained:—A is the outer funnel, which contains water, and into which steam is passed for heating purposes; B, inner funnel for filter; C, flask containing water; D, flask to collect filtrate; E,



Filtration of Oils by Heat.

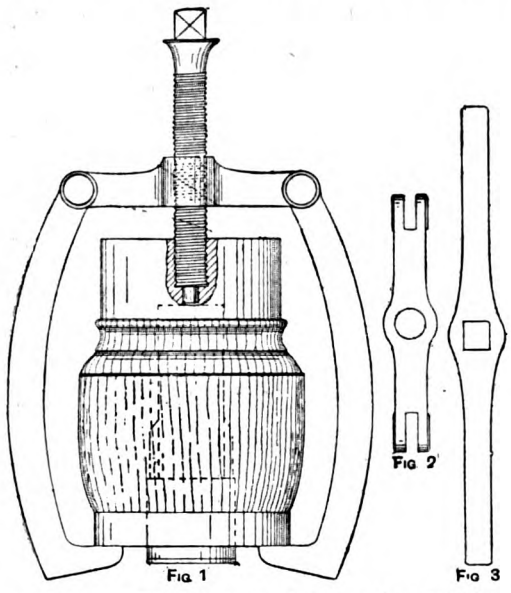
glass tubing (steam from C is passed along the tube to A); F, burner to heat flask; G, tripod stand to support flask.

Manufacture of Porcelain and Earthenware Goods.—The finer qualities of earthenware or porcelain goods are manufactured from mixtures of various clays, calcined bones, etc., from which every organic constituent has been burned out. All these ingredients are weighed, and mixed together in a large quantity of water, and strained through very fine sieves. When the clay has been allowed to dry till of the consistency of dough, it is placed by the potter on a horizontal revolving wheel, and the lump of clay may become a bowl, vase, or any other article. When the object is sufficiently dry, it is ready for the "biscuit" kiln, or first firing, where it is only partially baked. The design is then painted or printed on—that is, underglaze, or before the metallic glaze has been applied. The ware is now ready for dipping into glaze, literally a form of ground glass which the half-cooked ware, being very porous, readily absorbs. It then undergoes its final firing at a much lower temperature than that of the biscuit oven. All articles are placed in saggars, or receptacles of coarse clay, which are next packed in a kiln; this is simply an oven arranged with flues in such a way as to equally distribute the heat. The fire is not allowed to touch either saggars or ware, as in the manufacture of coarser goods such as bricks or terra-cotta.

Blackening and Bronzing Brass.—To obtain a black colour, dip the brass in a strong solution of copper nitrate or copper sulphate, and then heat on a hot plate or hold the article in a Bunsen flame. To bronze the metal, dissolve 1½ oz. of copper sulphate in 1 pint of water, and pour in a solution of 1 part carbonate of soda in 2 parts water until the precipitate ceases to form. Decant, well wash the precipitate with water, and dissolve it in ammonia until the latter is saturated. This solution is warmed and the article dipped in it as before.

Self-winding Clocks.—Many have been made. Some of these are being continually wound up by means of a fan placed in a tall chimney shaft, up which there is a natural draught that always keeps the fan revolving. The fan is connected to the winding shaft of the clock by suitable gearing of a speed-reducing nature. Other clocks are driven by electricity; an impulse is given direct to the pendulum at each vibration by the closing of an electrical circuit in which is a weak battery made by burying carbon and zinc plates in moist earth. Perhaps the most noteworthy perpetual clock is in the British Horological Institute, 36, Northampton Square, London, E.C. It was made more than a century ago, and is dependent for its motive power on the variations in the density of the atmosphere. A sort of barometer containing many pounds of mercury is suspended from a rocking bar, and the constant shifting of the mercury causes the suspending bar to rock and drive the winding arbor by a rack and pinion. This clock has gone for many years, and has only been stopped to be cleaned.

Machine for Withdrawing Axle Boxes from Wheels.—Fig. 1 shows the machine in position on a stock of a wheel ready to force the axle box back. The top corners are made with knuckle joints, so as to allow of side play to take various sizes of stocks, the top boss-piece being made as Fig. 2, having good stout rivets through the joints. For ordinary work the sides should be made of iron, 1 in. wide by ¼ in. thick, with a good broad duck foot at the bottom. The top cross-piece is made with a boss large enough to take a 1-in. screw; this has a collar and square on the top end to take the handle shown in Fig. 3, the bottom end being turned down to ⅞ in. so as to form a shoulder for the circular bolster to rest upon. In use, the cramp is put on the wheel as shown in Fig. 1; the bolster, which is a trifle smaller than the outside of the box, is put on the end of the screw, and pressure applied by turning the screw down until the box, indicated by the dotted lines, is removed.

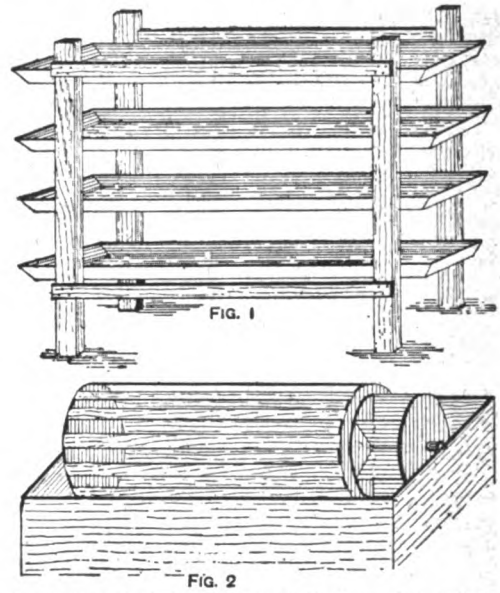


Machine for Withdrawing Axle Boxes from Wheels.

Recipes for Cheap Red and Black Paints.—For a cheap black paint for rough outside work, melt together equal parts of pitch and coal-tar, and thin to a working consistency with coal-tar naphtha. The naphtha may be dispensed with if the melted material is applied hot. A cheap red paint can be made by slaking lime with water and adding sufficient red oxide or Venetian red to colour it; apply it as if applying whitewash. Allow it to dry, and then brush over with silicate of soda solution (1 part of silicate to 4 or 6 parts of water). This paint will be found very durable.

Painting Lines on a Glass Plate.—To paint narrow lines on a plate of glass such as is used for show signs, first clean the side of the glass to be lined with a few drops of ammonia in warm water; then polish with a piece of soft paper, and lay the glass flat. Mix the colour in turps. Dry colour ground in turps is best, bound with japan gold size; do not use more than 1 oz. of gold size to 1 lb. of colour. Put the colour on a piece of glass, and charge the lining pencil with the colour. Let the second finger rest on the edge of the glass as a guide; hold the pencil between finger and thumb, and draw your hand towards you. If only a few lines are to be painted, perhaps it would be better to use a sign-writer's brush, and, when the lines are quite dry, to cut them straight with a straight-edge and sharp chisel. Lining pencils are made from sable hair, are from 2 in. to 2½ in. long, and are called lark, crow, duck, goose, and swan, swan being the largest.

Apparatus for Washing Large Photographic Prints.—Large prints are not generally washed in the mechanical manner adopted for small prints, because of the difficulty of keeping the prints from clinging together, and the impossibility of changing the water with sufficient frequency. Unless some such arrangement as described below is used, each print should be washed by itself. The accompanying sketches show two forms of washing machines for large prints. In Fig. 1 four trays are shown placed in a rack; each tray is in turn tilted to a slight angle to allow the water to run into the tray beneath. The trays may be of enamelled zinc or of wood coated with paraffin wax; they rest on four rails (not shown) supported by vertical posts.



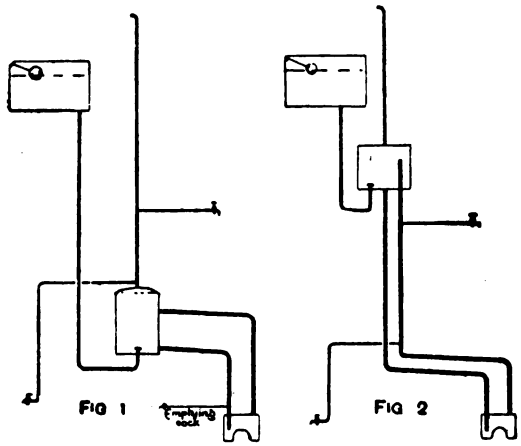
Apparatus for Washing Large Photographic Prints.

Fig. 2 shows an arrangement for washing unusually large prints. In this case the developing tank, being deep and long, may be used as a washing trough. The washing machine consists of two circular discs of wood (the ends of tubs), bored in the centre to receive an axle (a broomstick), at each end of which a disc is fixed, thus forming the framework of a skeleton cylinder, the ribs of which are laths stretching from one disc to the other, and nailed at each end. Around this cylinder the print is fastened with wooden clips. At one end of the cylinder sufficient space is left for a small water-wheel, which may be driven by water from the tap above it. The outflow is regulated by a plug, thus keeping the water in the trough always at the same height.

Making Clinical Thermometers.—These, like ordinary chemical thermometers, are made from special tubing with a capillary bore. The bulb is blown by a mechanical blower. The arrangement for preventing the mercury running back into the bulb is very simple. A very small bulb is blown so that the capillary tube becomes somewhat widened a little above the bulb. While the tube is still hot it is nipped or pressed so that the enlargement becomes much flattened; the flattening of this bulb breaks the thread of the mercury, so that on cooling the mercury in the tube above the constriction remains, while that below runs back into the bulb. On heating, the mercury easily rises through the constriction.

Hoop-iron Bond for Brickwork.—Hoop-iron bond is either a plain band of iron, such as is used to fasten bales of goods, about 1 in. wide by No. 20 gauge thick, or it is stouter, and specially made with triangular stabs in it to cause projections, as in Tyerman's patent. In either case it is usually tarred and sanded, and then laid in the courses of brickwork parallel with the face, one to each half-brick thickness of wall, and at such intervals in height as may be directed by the architect. The object is to strengthen the wall, especially where settlements are liable to take place. Sometimes it is laid in footings only, at other times at the angles of a building; and again, it may be usual as a virtual stringcourse round a building between the successive floors. The only disadvantage that could be caused by its use would be due to rusting if insufficiently protected and laid in a damp wall.

Usual Simple Forms of Hot-Water Apparatus.—The sketches below represent the two commonest schemes of hot-water apparatus in their simplest form. They would be erected thus for small property, and also for large property if some of the many special requirements or conditions to be found in large houses did not exist. Fig. 1 shows the cylinder system of apparatus, to which this name is given because in it a cylinder is nearly always used instead of the square tank. A square tank may be used when the apparatus only extends, say, 12 ft. above it, but when more than this a cylinder is used, because a square reservoir will not bear the pressure. The connections must be made as

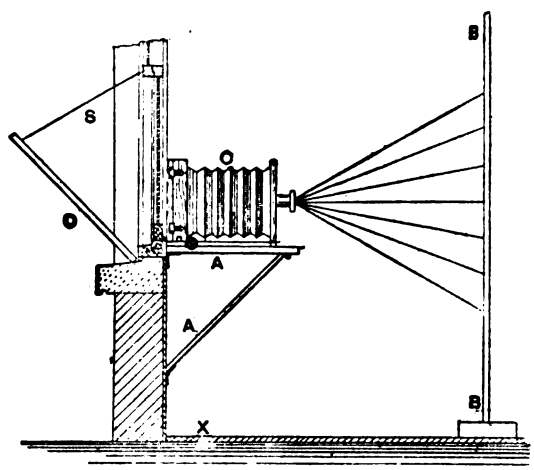


Forms of Hot-water Apparatus.

shown. Draw-offs can be from any point on the expansion pipe up to the level of the water in the cold cistern. The reason the hot water does not run out of the top of the expansion pipe is that this pipe is carried up at least 2 ft. higher than the cold-water cistern which feeds the apparatus. Fig. 2 shows the tank system of apparatus, so called because a square tank is used and not a cylinder, although the latter can be used if desired (the square tank costs less). In this apparatus the tank is fixed above the highest draw-off, and usually only a few feet below the cold-water cistern. The cold service is taken into the bottom of the tank, and an expansion pipe is taken from the top and carried to a height at least 2 ft. above the cold cistern. Draw-offs can only be taken from the flow pipe, not the return, as the latter seldom has hot water in it.

Tuck Pointing and Re-colouring Brickwork.—The method generally adopted for colouring ordinary brickwork is to apply with a brush a solution of green copperas (1 lb. to 5 gal. of water). This should be tried on a few bricks, and allowed to dry before applying it to the whole front; sometimes two applications are needed. Use, when the bricks are of a superior quality, a wash formed of 1 lb. each of Venetian red and Spanish brown to 1½ gal. of water, in which has been dissolved, while the water is hot, ½ lb. of white copperas, or alum. This should also be tried on a few bricks, and allowed to dry before applying it to the whole front. The joints should be well raked out, and the front washed and brushed with a stiff brush. When the work is dry, apply the colour; and after this has dried, prepare the stopping. The mortar for this is coloured with Venetian red and finely sifted smith's ashes or foundry sand, unless red sand can be procured. This must also be tried on a few joints and allowed to dry, to see that it is of a suitable colour. No more stopping should be done in one day than can be jointed, for if the work is allowed to dry the white putty will not adhere. The putty is formed of finely sifted white lime mixed with linseed oil, and silver sand, or marble dust, the latter being preferable if it can be obtained. The putty is applied with a steel jointer of the width of the joint, on a rule about 7 ft. long. The rule should have three blocks of wood, ½ in. thick, on the back, to allow the cuttings from the joints to drop clear. The joints are cut with a knife called a "Frenchman," the end of which is turned up at right angles. The vertical joints are laid on from a board formed like a set square, with a wooden handle on the front, like the handle on a plasterer's hand float. It should reach three courses in height. When the joints are all laid on and cut, go over the work with a soft brush to remove all dust. A sufficient quantity of colouring and stopping should be mixed at one time to cover the whole. The tuck pointing should be ¼ in. thick.

Enlarging Photographs by Daylight.—For making enlargements by utilising the window of a dark room, construct a bracket A (see illustration) and an upright easel B, running in guiding rails X. Outside the window hinge a reflector D, consisting of a white board about 24 in. by 20 in., held at an angle of 45° with the window sash by a cord S passing through the joint of the window frame. The camera C, preferably one with a movement of front for focussing or a lens with rack and pinion, is placed on the bracket as shown. The ground glass of its focussing screen may be removed and the



Enlarging Photographs by Daylight.

negative inserted in its stead, or a carrier may be made to fit the slide grooves. Another plan is to place the negative in the dark slide, removing the partition and withdrawing both shutters. The size of the enlargement will depend on the distance of the easel from the negative and the amount of extension of the camera. The finer focussing having been done on a sheet of white paper, make a cap of ruby glass to fit over the lens, pin up the bromide paper on the easel, and, if the position is correct, remove the cap and expose. Light must reach the easel only through the negative.

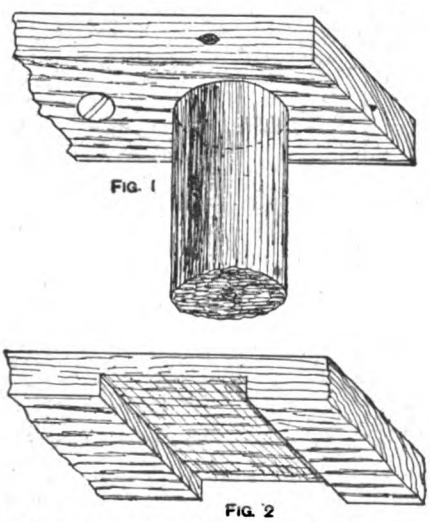
Staining Pine to Imitate Chippendale.—To stain yellow pine in imitation of Chippendale mahogany, procure some burnt sienna, ground in water, mix with stale beer, and add a small quantity of vandyke brown and rose pink; mix well together. Apply rather liberally with a brush, then wipe off with clean rag, finishing in the direction of the grain. This will form the foundation. The exact tone required is built up as the polishing proceeds by adding a small quantity of Bismarck brown to the polish to impart redness, black for a darker tone, and rose pink for the peculiar purple tone that characterises some Chippendale goods. The colours should be evenly distributed. Should any difficulty occur in applying them with polishing pads, use a camel-hair brush.

Dissolving Gum Copal.—Copal varies in quality, as hard, half hard, and soft, and gives best results when dissolved in properly heated vessels. Soft gums contain a small percentage of water, and if cold turpentine is added to the gum when dissolved in spike oil, precipitation is the result. Copals do not readily dissolve by cold solvents unless the gums are powdered; they may then be dissolved in spike oil, if thoroughly mixed. To prevent precipitation when thinning out, use one part of spike oil and nine parts of turpentine free from adulteration.

Demagnetising a Watch.—Place the watch over an alternating current transformer so that it is in the magnetic field, and then decrease the current gradually to nothing. Another way is to spin a bar magnet just over the watch and gradually to withdraw it; or the watch may be revolved over the fields of a continuous-current dynamo, and gradually withdrawn from the influence.

Determining Speed of Photographic Shutter.—Choose an object, say the wheel of a bicycle, which may be got to make exactly one revolution per second. Fasten to one of the spokes near the tyre a disc of bright tinfoil, and focus the wheel as large as the plate will allow. When the wheel is making one revolution per second release the shutter. Now, without altering the camera, make an exposure with the wheel at rest to serve as a measuring chart. On development it will be found that the first exposure shows an arc or smudge of light. The proportion which this arc bears to the complete circle is the proportion which the shutter exposure bears to one second, so that all that remains is to measure the arc with a pair of compasses and divide the circumference by it. For a brief exposure of less, say, than one-fiftieth of a second, it is necessary to have a special arrangement by which a wheel can be rotated at a much higher speed and with greater certainty.

Fastening Legs to a Bamboo Table Top.—Fig. 1 shows a simple method of fastening the legs. Strips of deal or other suitable wood are bored to receive

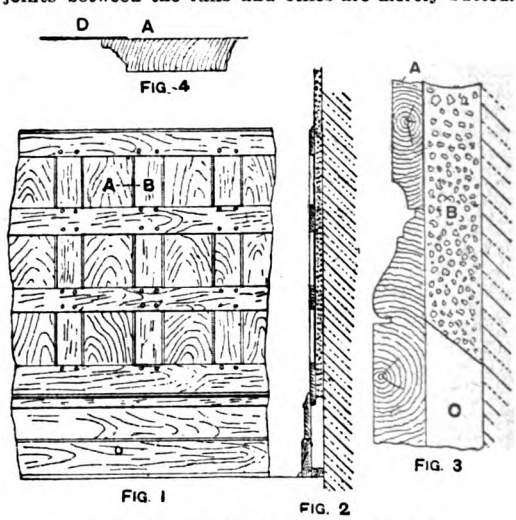


Fastening the Legs to a Bamboo Table Top.

the top ends of the legs, which are glued and fastened with a sprig as indicated. The strips should be halved and glued together where necessary (the halving of one piece is shown at Fig. 2), and secured to the underside of the top with a few screws.

Timber-framed Buildings.—There are many ways of constructing these, but three methods adopted where cost is a consideration are as follows:—(1) Planting 7 in. by 2 in. deals on the face of a wall; (2) framing timbers together the half thickness of the wall and then filling in the panels with rough deal studs to receive the laths and plaster; and (3) using metal lathing instead of the ordinary deal laths. These methods have only cheapness to recommend them. To properly construct such a building, the timbers of all the angles should be the full thickness of a 9-in. wall, in fact, 9 in. by 9 in.; sills, 9 in. by 6 in.; heads, 9 in. by 6 in.; other timbers, such as curved pieces, studs, and rails, 6 in. by 4 in. The timbers are grooved on the sides, jointed together by the mortise and tenon joint, and secured by 1-in. oak pegs, to project ¾ in. from the face of the wood. The sills should project 1½ in. from the face of the brickwork, and be moulded and throated on the edge. Between the timbers—that is, in the panels—this is filled with 4½-in. brickwork, 1 in. back from the face of the wood, to allow of sufficient room for the stucco. Behind the whole of the timber framing another 4½-in. wall is built, to make it the full thickness of the wall below; consequently the timbers that are the full thickness of the wall will be seen from the inside, which should be covered with flat-headed nails to form a key for the plaster. After this, the outside of the panels is covered with Birmingham adamant cement work to ¾ in. in thickness, the groove in the timbers acting as a key. The timbers are coated twice with Carbolineum Avenarius, once before fixing and once after, so that the blackness of the timber may contrast pleasantly with the whiteness of the plaster. Memel, deal, pitch pine, and oak are each used in the construction of half-timber framing. Good red deal, if it were possible to obtain it in the sizes required, would be preferable to pitch pine, which is liable to crack and open under the influence of the weather, but the use of deal is, from the cause already mentioned, greatly restricted, pitch pine being chosen instead. In the majority of cases, oak is out of the question on account of its cost; but, if a good job is required, and when expense is not a prominent consideration, oak is the wood to be used.

Method of Panelling with Veneers.—Wood panelling, although a very suitable and much-used enrichment, is generally very costly. The following is a strong and effective method of fitting it at a greatly reduced cost. First cut some oak veneer into sheets about 2 in. longer each way than the required panels. Mark the lines of the framing on the wall, and glue these sheets to the plaster, overlapping the marks 1 in. all round. The wall having been previously plugged, fasten to it pieces of oak, each about 4 in. by ¾ in., to form the framing, which thus holds the veneer. The joints between the rails and stiles are merely butted.



Method of Wood Panelling with Veneers.

Sham pins, either cut off flush or left projecting for ¼ in., may be added if desired. Fig. 1 shows an elevation of panelling with an old-fashioned treatment of the mouldings, consisting of a double fillet and chamfer run on the upright members only, and butting on the horizontal ones, which are left square. Fig. 2 is a section illustrating the new method of fixing the framing. The panelling is solid, leaves no space to harbour vermin, and can be polished, stained, or otherwise finished in the same manner as ordinary panelling, while its cost is considerably less than one-third that of the latter. A further advantage is that, as it is much thinner than ordinary work, the skirting, if already fixed, need not be taken up and brought forward; for with suitable mouldings on the bottom edge of the bottom rail of the panelling a neat junction may be effected. Fig. 3 shows a method of treating mouldings for this purpose, while Fig. 4 is an enlarged detail section on the line A B in Fig. 1. In Figs 3 and 4, A represents the framing, B the plaster, C the ground, and D the veneer. If a bolection moulding is preferred, it should be remembered when designing it that the general character of a moulding arises from the contrast of curves with sharp edges: and, at the same time, the chief divisions of the mouldings should not be equal in size, as this tends to produce a coarse effect. Two or three small delicate mouldings, followed perhaps by a bold ovolo or scotia, and then by smaller mouldings again, should, if properly managed, give that idea of richness which mouldings are intended to convey. It may be noted that oak-wood panelling is, as a rule, better left rough from the scraper, and, except when it is to be polished, not touched with the glass paper, as this clogs up the grain.

Painting Clock Dials.—To repaint clock dials, all the old paint must first be removed, and the plate cleaned thoroughly from grease. The white ground can be painted with white enamel, obtainable in d. and 6d. tins. These enamels dry hard and glossy. The figures may be painted with black enamel, with a fine camel-hair brush. If only a single dial is to be painted, the figures may be spaced out on a piece of paper a little smaller than the dial plate; when this paper is laid upon the dial to be painted, the marks can be easily transferred to the minute circle.

Covering a Small Roof with Zinc—A small roof of the shape indicated in Fig. 1 may be covered as shown in Fig. 2, which is a section across one roll at A—B (Fig. 1); Fig. 3 is a section on C—D of the end roll showing apron to weather the joint to brick at the gable end; and Fig. 4 a section on E—F showing the eaves dripping into a zinc

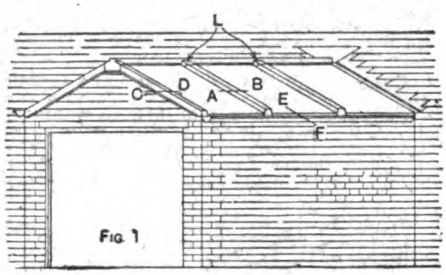


FIG. 1

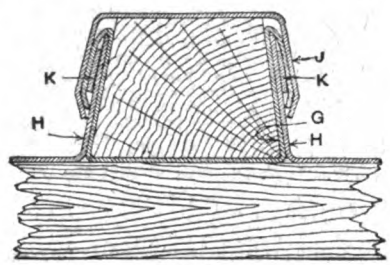


FIG. 2

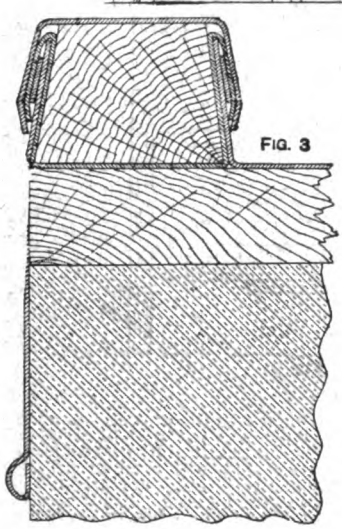


FIG. 3

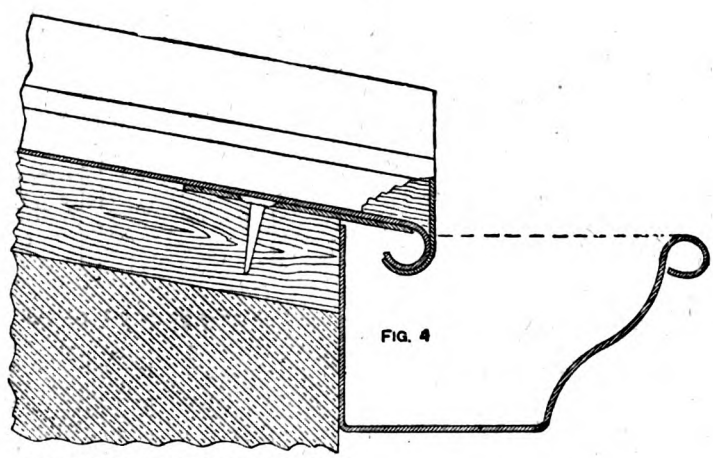


FIG. 4

Covering a Small Roof with Zinc.

gutter. In section Fig. 2, G is a tack or clip about 2½ in. to 3 in. wide, H the stand-up of the bay, J the roll cap, and K a fork or pointed strip with one end soldered to the under side of roll cap. On sliding the latter into its position, the loose end of the fork passes under the clip G and thus forms an invisible fixing. The top ends of the bays are turned up against a ridge roll which has a capping similar to A—B. If the ridge roll stands up about 1½ in. to 2 in. above the others, the saddle pieces shown at L (Fig. 1) are unnecessary. For fixing the eaves gutter, bridging pieces of zinc tube are soldered in, and through these long screws are passed for fixing to the ends of the boards, or to a fascia board if one is used.

One-solution Developers for Photographic Negatives.—These developers are usually employed for the development of snapshot exposures, and are therefore compounded for under-exposed plates. The following are given in grains per ounce, from which any quantity may be made up by first finding the capacity of a suitable bottle and multiplying each item by the number of ounces. Use just sufficient hot water to dissolve, then fill up the bottle, shaking occasionally. No. 1: Sulphite of soda, 100 gr.; yellow prussiate of potash, 40 gr.; hydroquinone, 25 gr.; caustic potash, 40 gr.; water, 1 oz. Dissolve the potassium hydrate separately. Use 1 part with 3 parts water. Where more exposure has been given, as much as 9 parts water may be used and 10 drops per ounce of 10-per-cent. solution of potassium bromide. No. 2: Sulphite of soda, 75 gr.; carbonate of potash, 100 gr.; glycine, 20 gr.; water, 1 oz. Add glycine last. Use 1 part with 3 parts water. No. 3: Sulphite of soda, 50 gr.; water, 1 oz.; amidol, 5 gr. The soda should be kept as a 10-per-cent. solution, and the amidol added only when required. No. 4: Metol, 3 gr.; sulphite of soda, 40 gr.; hydroquinone, 4 gr.; carbonate of potash, 20 gr. Dissolve the metol first. Use 1 part with 1 part water, and, if necessary, 2 drops per ounce 10-per-cent. solution of potassium bromide. The following formula for a single fluid developer which will not stain the fingers may be used for either plates or paper:—Dissolve 24 gr. of metol in 10 oz. of distilled water, add 1 oz. of sodium sulphite, 40 gr. of hydroquinone, and ½ oz. of carbonate of potash or soda. For use, take one part of developer and one part of water and add 1 drop per ounce of 10 per cent. solution of bromide of potassium. It is preferable to increase this to 4 drops per ounce for bromide paper.

Renovating Plaster Bronzes.—Brush them carefully with a soft brush and paint the surface with gold size, and, when this is sticky after standing a short time, apply the bronze powder with a pad of chamois leather. Dry in an oven till the coating is hard, then apply copal varnish and finally stove the bronzes.

Cementing Leather to Iron.—For uniting leather to iron, use marine glue, which is made by dissolving 1 part of pure indiarubber in 12 parts of coal-tar naphtha. After solution is complete, add 20 parts of powdered shellac; warm the mixture gently, and stir from time to time until properly amalgamated. As the naphtha is very inflammable, the heating should be done in a steam bath in a closed pan. When made, the cement should be poured on a cold stone and allowed to set. Before applying the cement to the iron, the latter should be roughened with a file and heated. The leather also should be roughened on the back with glasspaper, drawn tightly over the iron while the cement is still pasty, and pressed into position until it becomes cold. Rubber tyre cement is practically a marine glue, and it may be obtained from most cycle-repairing depôts.

Making Gelatine Moulds.—When making gelatine moulds for casting plaster ornaments, etc., the glue or gelatine must be of good quality; it is soaked in water till soft, and melted over the fire in the usual way. The gelatine must be of just sufficient consistency to pour from the can and enter into the finest markings of the model. The mould should first be dusted over with French chalk, which is afterwards carefully brushed off. Before pouring in the plaster, oil the mould with paraffin oil in which a piece of composite candle has been melted. This will put a clean, smooth skin on the mould, and prevent the plaster from sticking. The cast should be removed from the mould as soon as possible, and before the plaster begins to heat. The mould will peel or scale on the casting through using poor gelatine, through not oiling the inside of the mould properly, through allowing the plaster to set and become warm before being removed, and through using the gelatine too thin.

Self-feeding Poultry Food Bin.—Fig. 1 shows a section and Fig. 2 a front view of the bin, which may be made of ¾-in. pine. The sides are made with the grain of the wood running from top to bottom, a ledge being nailed across the lower and top edges to prevent warping. A A (Fig. 2) show the lower ledges, those at the top being inside. The front (A, Fig. 1) extends from the top to a little less than half the depth, and from this a piece of tin forms the front of the hopper and reaches to the feed-hole B (Fig. 1), which should be of such a height from the ground that the poultry can

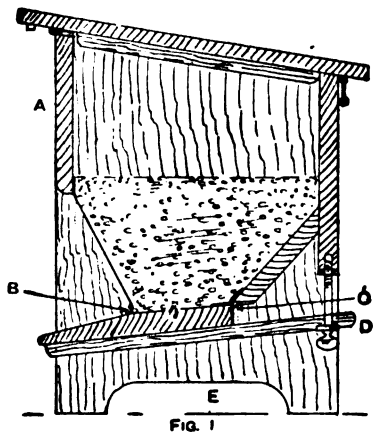


FIG. 1

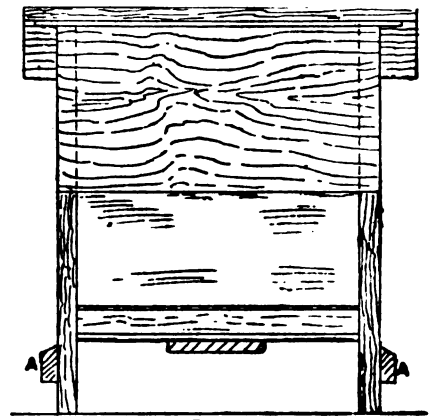


FIG. 2

Self-feeding Poultry Food Bin.

reach the grain. The feed-board is hinged to the back of the hopper at C, the joint being protected inside by a strip of canvas. A batten D is nailed across the grain of the feed-board to keep it from warping, and is extended through to the back, where a bolt with a thumbscrew is provided which may be turned to regulate the size of the feed-hole B to suit the size of the grains of corn that are being used. The sides are cut away in the centre at E to give a firmer bearing on the ground. A sloping roof is provided, fitted with hinges at the front and a hook and eye at the back.

Meaning of Tension, Compression, and Strain.—A body is in tension when a force, acting on it parallel to its axis, tends to separate its particles by drawing them apart. A compression force is one that acts parallel to the axis of the body and tends to force the particles into one another. In short, a body in tension has a pulling force upon it, while, if in compression, a push would be exerted on it. A strain was at one time considered as a force acting on a body, but the more modern idea is to consider it as the change of form in a body due to the application of a force.

Speed of Photographic Shutter.—There is no fixed speed at which a photographic shutter should be worked, because so much depends upon the strength of the light, the aperture of the lens, the speed of the plate, and the rapidity with which the objects it is desired to photograph are moving. The exposure will generally be as long as the moving objects will allow. When the distance from the camera to the moving object and the speed at which it travels are known, an excellent rule is as follows:—Divide the distance between the camera and object (in inches) by the focus of the lens multiplied by 100, and divide the result by the rapidity of motion (in inches) to obtain the answer in the fraction of a second. Thus, if the distance of object is 720 in., the focus of lens 7 in., the rapidity of motion 20 miles an hour or 352 in. per second; then $x = \frac{720}{700 \times 352} = \frac{1}{343}$ of a second, which is the speed at which the shutter must be worked to obtain a sharp image, assuming that the greatest amount of blur or confusion admissible in any point of light must not exceed $\frac{1}{100}$ part of an inch. It then only remains to find what lens aperture and plate will allow of so brief an exposure being given on such a subject and in such a light. For example, if *f*/8 at 12 noon in June requires $\frac{1}{125}$ of a second to secure desired density of negative, etc., then *f*/5·6 will be the nearest stop to give the correct result at the same time.

Black Paint for Lettering on Glass.—To make a black liquid suitable for writing letters on opal glass, take ¼ lb. of lampblack, dry, and place it on an iron plate, well saturate it with turpentine, then set fire to it and let it burn itself out. This will remove the grease—the non-drying oil—from the colour. Now grind it in hard drying mastic varnish, and thin with turps. It would be better to give the letters two coats of thin colour rather than one thick coat.

Dyeing Fancy Grasses Various Colours.—Allow the grasses to soak for some time in a very hot and strong solution of aniline dye in water. Those dyes which are not soluble in water may be dissolved in spirit, and the solution added to water. Some aniline dyes will colour direct in this way, but others require a mordanting or fixing agent. For fixing basic dyes, such as magenta, methyl violet, etc., the grasses should first be soaked in a hot solution of oak bark or of sumach. Many pretty shades may be obtained by first soaking in a hot solution of picric acid, and then in magenta, methyl violet, methylene blue, etc. For green, picric acid and indigo extract may be used. In all cases the dye solution should be strong and hot, or the dye will not penetrate. The grasses should be quickly dried after soaking in the colours.

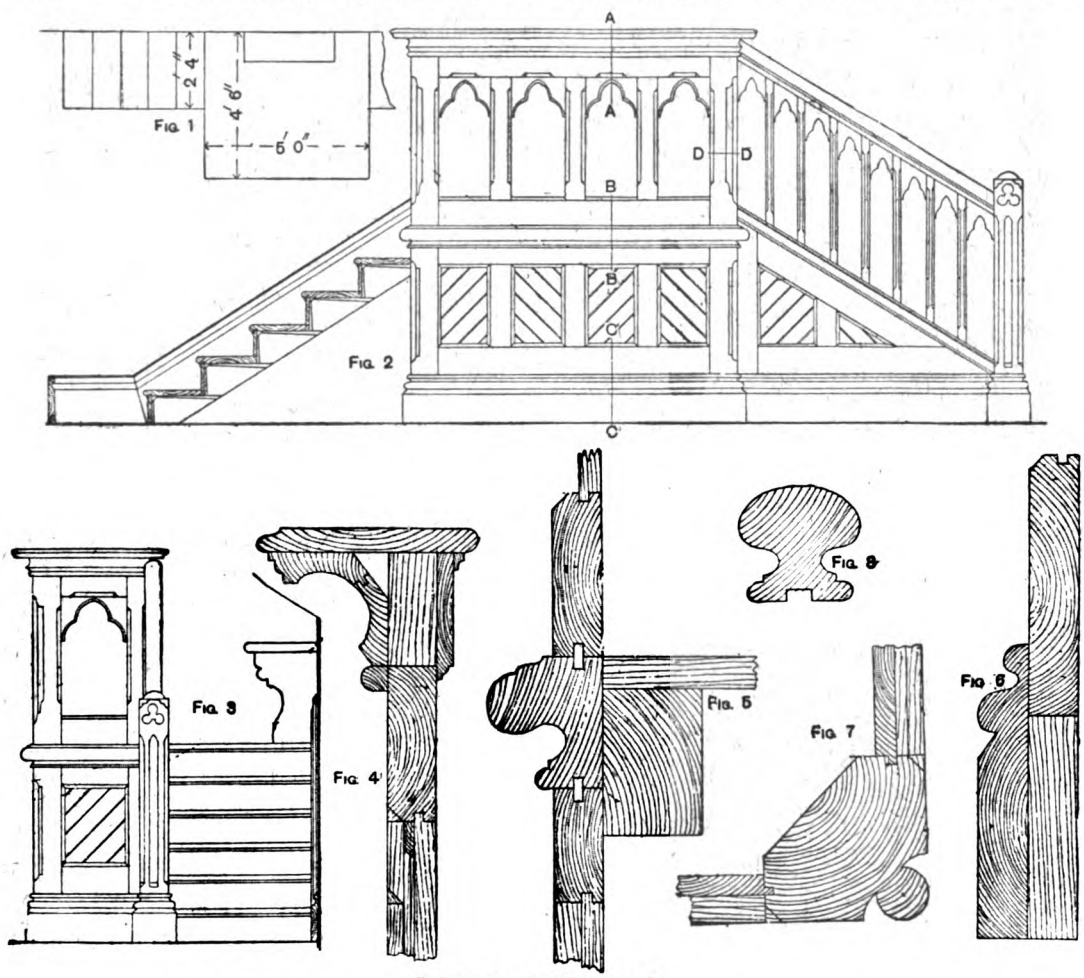
Tempering Cold Setts for Cutting Steel Rails.—The methods of tempering ordinary engineers' cutting tools are suitable for setts. Warm water is preferred by many, but cold water gives a harder temper. Water which has been long in use is better than fresh water. Chemicals are not necessary, though a little rock salt added is said to be advantageous.

Colouring Malleable Castings.—A good green colour is obtained on malleable castings by blackleading the castings, and then lacquering them, when heated, with a green lacquer. Or they may be painted over with bronze powder, which may be obtained of various colours and tints, rubbed up in best varnish, and heated in a hot japanning stove. But the best way is to have them bronzed by electro-deposit of copper, brass, or other metal; or they may be tinned in the ordinary way, and then lacquered with yellow or gold lacquer when heated in a stove or on a hot plate.

Fixative for Pencil Drawings.—Pencil drawings made on ordinary drawing paper may be protected from smudging or becoming blurred by a thin coating of methylated spirit into which some resin has been dissolved. The varnish may be applied with a brush, but a better way is to blow it on with a spray, which may be obtained at any chemist's. A wash of milk over the drawing will also serve to fix it.

Varnish for Kitchen Chairs.—Such chairs are generally made of birch; the commonest kinds are brushed over with glue size stained with venetian red, then varnished with common varnish heavily stained. The better kinds are stained with burnt sienna and size or stale beer, then bodied up with red polish and varnished. One pennyworth of Bismarck brown, added to 1 pt. of varnish, imparts a powerful red tone. Shellac 4oz., resin 2oz., benzoin 2oz., and methylated spirit 1 pt., make a useful varnish. Carefully strain. If the varnish is not thick enough, add more shellac; if it is too thick, add more spirit. Apply with a camel-hair brush.

Design for Small Pulpit.—Fig. 1 shows a sketch plan, Fig. 2 shows front elevation, with a portion removed on the left in order to show the stairs. Fig. 3 shows the side elevation. Enlarged details are given as follows:—Fig. 4, section through AA; Fig. 5, section through BB; Fig. 6, section through CC; Fig. 7, section through DD; and Fig. 8, section of handrail. The construction is fairly simple, but the pulpit would look effective if made of good deal and stained and varnished, or of pitch-pine varnished.



Pulpit for Small Chapel.

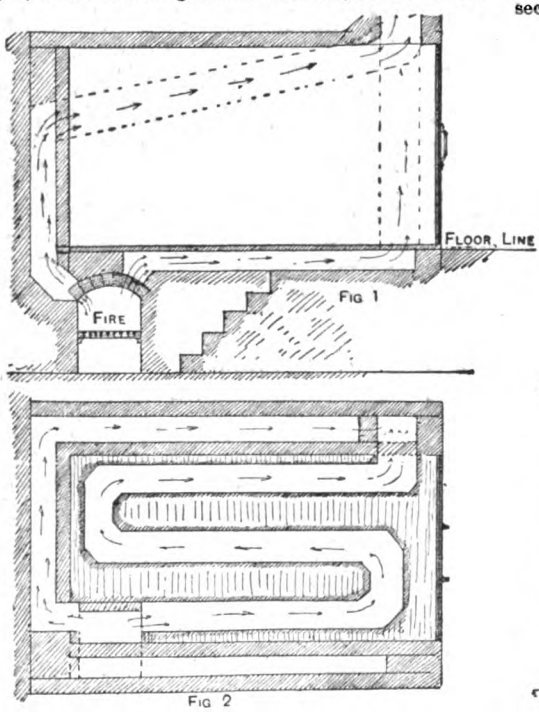
Painting a Cart.—To be used for trade purposes, it would look very well with the body painted chocolate lined out with vermilion; the under parts, such as shafts, wheels, etc., being painted a light yellow, picked out with a broad line of black, edged with vermilion. Another colour for hard wear and to look well is a good dark green, the body fine-lined with a lighter green, and the under parts picked out with the same colour as the lines on the body, and edged up, or gauged off with a fine line of a straw colour. Blue cannot be recommended for the purpose, as it has a tendency to fade and turn white: but if used for the body it should be fine-lined yellow and the under parts painted red picked out in black. In pleasure carts it is customary to have the bodies black, without any lines at all, excepting the front seats and brackets, but the kind of vehicle determines in a great measure the manner in which it is to be finished. It may perhaps be as well to add that the broad lines on a trap, usually on the centre of the spokes, shafts, and springs, represent "picking out," whilst fine lines are the smaller ones sometimes used by themselves, when they are called counter-lines, and at other times edged on the picking out, or run up the centre of the same, when they are termed split lines.

Boring Holes in Bricks.—For boring holes about ½in. or ¾in. diameter at any place in an ordinary brick wall, an old twist-bit used as a boring tool may be made to serve the purpose: a piece of steel tube, such as cycles are made with, will, if jagged at the end, answer very well. These tools are only suitable where the bricks are fairly soft; with hard bricks it is quicker and easier to make holes with a chisel and hammer in the usual manner. Holes may be very quickly drilled in brick or stone walls by making the cutting end of the drill in the form of a cross with four cutting edges. The drill is held in one hand and rotated while being struck with a hammer. When the holes are required to be deep, a projection may be made in the outer end, by which it can be knocked out of the hole quickly. The cutting end should be larger than the shank, so as to allow for clearance, and the shank should be sufficiently long to allow a hammer to be used for knocking it out of a deep hole.

White Cement Floor.—For making a hard white cement floor for a room, lay an ordinary cement concrete foundation, about 5in. thick (4 to 1), and on this lay a coat, 1in. thick, of Portland cement and clean white sand (1 to 1). Such a floor has a white appearance when dry.

Efficiencies of Water Motors.—For small power purposes, for pressures of 50 lb. per square inch and upwards, if efficiency is defined as the ratio of the work received from the motor compared to that put into it, the following list may represent the efficiencies of various water motors when used in circumstances that suit the special types considered:—Undershot wheel, 25 to 45 per cent.; low breast, 40 to 65 per cent.; Poncelet, 60 to 70 per cent.; high breast and overshot, 60 to 80 per cent.; and turbines from 60 per cent. upwards. Undershot wheels and Poncelet wheels are suitable for heads of 6 ft. and under; breast wheels for heads over 6 ft.; overshot wheels, from 10 ft. to 60 ft. or 70 ft.; and turbines for any head according to the design of the wheel. A pressure of 50 lb. per square inch corresponds to a head of $50 \times 2{\cdot}31 = 115{\cdot}5$ ft. The Jonval (parallel or axial flow), Fourneyron (outward flow), Thomson (inward flow), and Schiele (mixed flow) turbines are suitable for pressures.

Hot-air Oven.—The modern hot-air oven suitable for enamelling and japanning here shown is about 10 ft. by 8 ft. by 7 ft. high, with iron swing doors in front. An ordinary furnace fire, fire-brick lined, is built at the further end of the oven opposite to the smoke flue (see Fig. 1, which is a longitudinal section), access to this

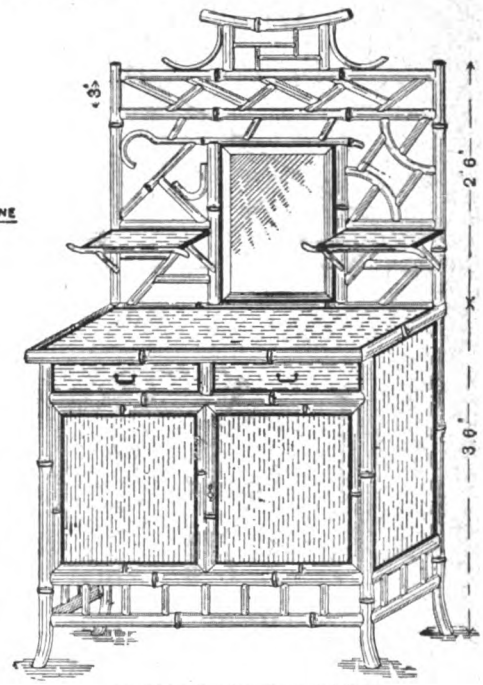


Hot-air Oven.

furnace fire being obtained by a flight of brick or stone steps. Ordinary furnace bars form the grating, with a cast furnace door in front. From the right-hand side at the back of the fire-box the brick flue is carried in the brick floor, as shown on plan (Fig. 2), crossing the floor three times, and then up the side wall into the smoke flue. These flues are covered with fire-brick slabs in the usual manner, forming the floor of the oven. On the left side of the back of the fire-box a similar flue is built into the back wall in a direction slanting upward; this is carried along the side wall, and thence into the smoke flue. Doors should be fixed in suitable positions for the cleaning of the flues. If more convenient to have the smoke flue in another position, it is only necessary to alter slightly the direction of the flues. The size of the furnace must depend on the size of the oven adopted.

Making a Hair Mattress.—The top of a hair mattress is made of sateen Leeds ticking, bordered with fancy striped Belgian. The underside can be covered with fine hessian, but if made of the same material as the top the mattress can be reversed. Seam the material to the required width of the mattress, then machine on a border of Belgian all round, 5 in. wide; this will give the mattress a thickness of 4 in. Let the stripe of the border run the opposite way to the cover. Fold in the corners neatly, and make a small roll by running a seam ¼ in. from the outside edges all round the top and bottom. For best work these rolls are piped with cord. Fill the mattress with curled hair, and tuft in rows 6 in. apart with strong twine and red woollen tufts. To make the mattress square and firm at the edges the sides are stitched up with two or three rows of blind stitches. For this purpose an upholsterer's 9-in. double-pointed mattress needle, threaded with twine, must be used, the needle being passed through the side about 1 in. from the bottom edge, and brought out, but not drawn through, 6 in. from the edge on the top; the needle is then, being double-pointed, backed out on the side about 3 in. from the place at which it was first inserted. When the needle is pulled up tight all the hair contained in the stitch is drawn up to the edge of the mattress. Stitch all round in this way as many times as necessary.

Design for Bamboo Cabinet.—In the accompanying sketch the uprights of top are 2 ft. 6 in. long, the cross rails 3 ft. 3 in., and the mirror 20 in. by 15 in. Use 1¼-in. or 1½-in. canes for the work. Make up the front and back of the cabinet in the first place, and, while these are setting, get out the back of the top. The two bottom sections should now be joined together. The rails should



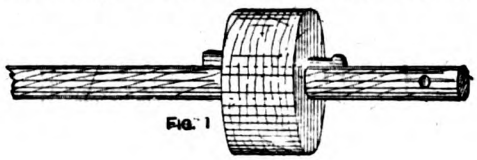
Design for Bamboo Cabinet.

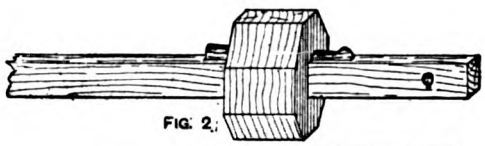
be about 10 in. between if the cabinet is to be 13 in. wide over all. Make the door frames from perfectly straight 1-in. canes. These canes should be mitred at the corner, and a right-angle dowel should be used for filling. The rebate for the glass should be formed with split black cane. The doors work on pins, which act as pivots.

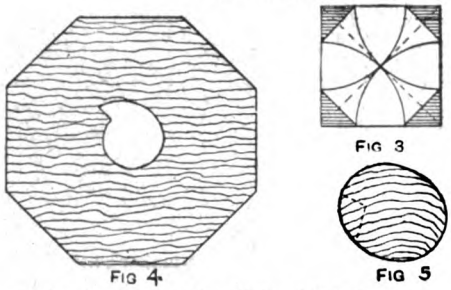
Renovating Brasswork of Bedstead.—Take the loose brasswork to pieces and boil off the old lacquer in a hot solution of carbonate of soda and water—1 lb. of carbonate to 1 gal. of water; then swill the parts in clean water. Repolish with strips of flannel "list," to which is applied a mixture of lime and oil. Then clean off with dry lime, and relacquer with a camel-hair brush. The work should be held in some way, preferably in a vice.

Darkening a Mahogany Picture Frame.—To darken a Spanish mahogany picture frame, dissolve 1 oz. of bichromate of potash in 1 pt. of warm water. Apply the solution with a sponge or brush, getting it well into all quirks or hollows; wipe off any surplus with rag. Several coats may be given till the desired tone is gained. When dry, wipe over with raw linseed oil; smooth down by well rubbing with coarse rag or finest-grade glasspaper. The work may be finished with French or wax polish.

How to Make a Pencil Marking Gauge.—This tool is not generally found among woodworkers' tools, but if it were more adopted it would be found an advantage over the common rough way of using the fingers and pencil as a gauge. It will be seen from the figures that there are several ways of making the tool. Any hard wood will do for making this gauge, but beech is preferable. A piece of wood about 1 ft. long and 1 in. thick (see Fig. 1) should be chucked in the lathe for the stem of the gauge. This is carefully turned to ¾ in. in diameter, except the end nearest the back poppet centre, which is left a trifle thicker than ¾ in., so that the head of the gauge may be turned on it. For the head a piece of wood 3 in. square and 1¼ in. thick will be required; two lines drawn from the corners will determine the exact centre of the block. At the centre on one side of the head a hole should be bored ¾ in. in diameter with a sharp centre-bit half through; the block is then turned over, and the other half bored; this ensures the hole being true. The corners should be cut off the block, so that it may be more easily turned; it is then fixed tightly on where the stem was left thicker; it should be a tight fit. The head should now be turned, so that when finished it is just 2½ in. in diameter. To improve its appearance, the sides of the head may be polished while it revolves in the lathe; but before this is done the top and bottom of the head should be turned



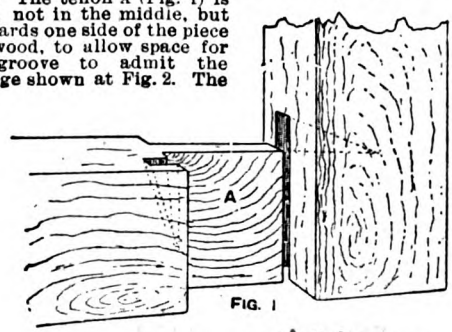


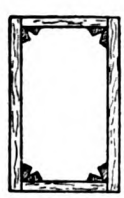


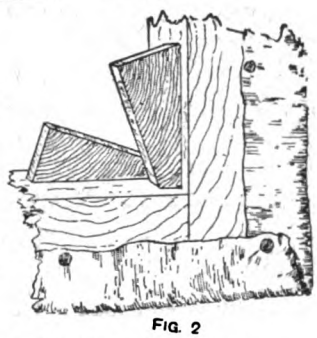
How to Make a Pencil Marking Gauge.

perfectly square to the stem, and as smooth as possible, so that when finished the head should measure 1¼ in. thick. The stem should then be turned, so that the head slides along its length without being too loose; the stem is then cut off about 10 in. long, the ends being cut square. Fitting the wedge is next to be done; it may be shaped with a chisel or fret-saw. The round on the thin end is to prevent the wedge when loosened from slipping out and being lost. The wedge should be 3 in. long and about ¼ in. thick. The groove in the head is cut to take the wedge; this may be done with a key-hole or fret-saw, finishing with a chisel; the wedge should fit easily without any shake. A hole the size of an ordinary pencil should be bored in the stem about ¾ in. from the end; a piece of pencil is fitted in, and the gauge is complete. The gauge illustrated in Fig. 2 is octagon in shape. A piece of wood 10 in. long is planed up ¾ in. square each way for the stem. The head being octagonal, it is best to make it square first; it should measure 2½ in. When perfectly true, the corners are cut off; it should be marked as shown in Fig. 3. This is done with a pair of compasses. Using the corner of the block as centre, and the middle of the block as radius, an arc is described to the side of the block; a line from the ends of these arcs marked across the corners, should make a true octagon. A square hole to take the stem should be cut with a ¾-in. chisel; a ⅝-in. hole should be bored through first to facilitate the cutting. Care should be taken to get the sides of the head square with the stem when it is fitted in. The head should also slide up and down the stem easily without side play. The wedge is cut to shape, and fitted as described for the round gauge; and the pencil is also fitted as described before. A good way to sharpen the pencil for these gauges is with a sharp chisel. It will be found that the gauge will be handy in using up odd ends of pencils. A different way of making it, which answers well, and is less trouble to alter, is shown at Fig. 4, which gives the end view of the head, showing the shape of the hole. The stem is cut the same shape as the hole in the head, but slightly shorter in the flange of the snail. To make the stem take a piece of wood 10 in. long, place the head on one end, and mark the shape of the hole on it. Do the same at the other end, and then plane the wood to an oval, as shown in Fig. 5. Cut a slot in it with a fine-backed saw, as shown by the dotted lines, and round off the inner corner. This gauge does not require a wedge to tighten it, but is fixed at any desired part of the stem by turning round, the shape of the stem acting as an eccentric. To loosen it, turn the stem in the opposite direction.

Frame for Working Embroidery.—The accompanying sketches of a corner and back view will give an idea of how to make a suitable frame on which to work embroidery. The tenon A (Fig. 1) is cut, not in the middle, but towards one side of the piece of wood, to allow space for a groove to admit the wedge shown at Fig. 2. The







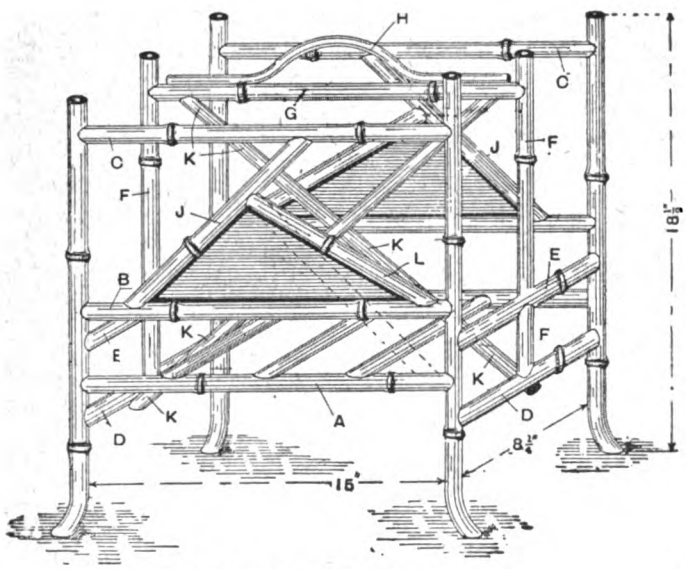
Frame for Working Embroidery.

dotted part shows how this groove is to be cut. The mortise is first cut to fit the tenon, and a piece chiselled out afterwards as shown by dotted lines. This space is for the second wedge. Fit the frame together, and tack the cloth on which the embroidery is to be done as shown at Fig. 2, and, if the hard wood wedges are then inserted, it will be seen that by tapping them with a hammer they will expand the framework in every direction, and thus strain the cloth quite equally. Fig. 1 represents a corner of the frame; Fig. 2 a corner with wedges inserted and cloth tacked on; Fig. 3 is a back view.

Making thin Glass Covers for Microscope Slides.—The semi-fluid glass is first blown out into a very large thin bulb and the blowpipe swung from side to side until the bulb elongates into a cylinder. The rounded ends of the cylinder are cracked off by applying a red-hot iron wire, and, with a straight wire, a longitudinal crack is made from one end of the cylinder to the other. The cylinder is placed on a flat stove in an annealing kiln for a few moments, when it softens and opens at the crack, gradually flattening out into a thin sheet. The circles are made by touching the thin sheet with a hot iron wire bent in the form of a circle, and the squares are cut out by applying hot, straight wires.

Deadening Sound coming through Party Walls.—The fault of sound coming through a party wall generally does not lie so much in the wall itself as in the joists. It will probably be found that the joists rest in the party wall, possibly touching each other, and that the sound is conveyed by the timbers, not by the brickwork. The skirting boards, too, may be acting as sounding boards. If this is the case, "jack up" the end of each joist, take out the brick below the end of it, and insert a thinner brick, with two layers of tarred felt between the brick and the joist, at the same time wedging a piece of felt between those joists that touch each other. The skirtings should be taken off, and the space behind filled with plaster. If the cause is really in the walls and not in the joists, try covering with one of the thick pulp papers, such as Lincrusta-Walton, anaglypta, or Japanese leather paper.

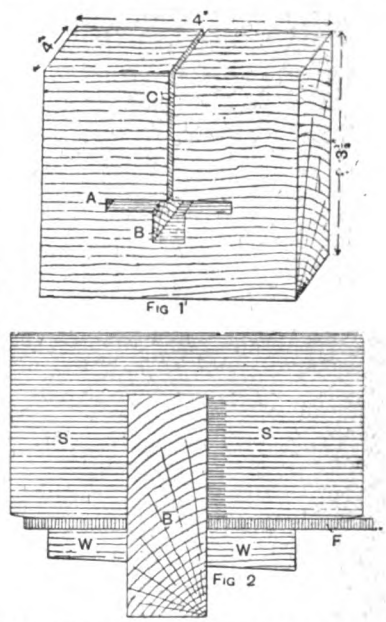
Newspaper Rack in Bamboo.—The rack shown in the accompanying illustration has four corner posts, each 19 in. long, slightly bent at the bottom to form the feet. The posts are connected by three rails A, B, and C, back and front, each 15½ in. long, and at the sides by rails D and E, each 9 in. long. There are also three cross rails running from front to back connecting the rails A. The rails E and the posts F (the latter being 13½ in. long) are halved where they cross. Connecting the posts F is a rail G 15½ in. long, to which the handle H, of ¾-in. cane, is fastened. Running from the



Newspaper Rack in Bamboo.

rail G are two ½-in. canes K, each about 19½ in. long, pinned together where they cross, and fixed underneath the rail D. An inclined rail J runs from B to C, the lower end being 1½ in. away from the corner post and the upper end being 5½ in. Another rail L, 9 in. long, inclined in the opposite direction, meets the rail J about 3½ in. from the top, and in the triangular opening thus formed panels are fixed. The dotted lines indicate how the cane L might be fixed if a variation in the design is desired. In this case the rail B would terminate where it meets L. The centre of rail A is 6½ in., and the centre of B 9½ in., from the ground, and the distances between centres of D and E 3½ in.

Sharpening a Cabinet-maker's Steel Scraper.—A scraper, to be of any use, must have the edge as keen and sharp as possible. The contrivance shown in Figs. 1 and 2 for trueing the edge of a steel scraper does away with the necessity for a vice, or even a bench. It is so simple that it can be used without risk of rounding the edge of the scraper. It is easily made from a piece of any kind of hard wood, 4 in. long, 3½ in. deep, by 1½ in. thick. Dress up the piece of wood to size, and cut out the slot A (Fig. 1). The slot should be wide enough to allow a flat, fine cut file being easily slipped through, and it should also be twice as long as the file is wide, so that the full breadth of the file may be made use of for trueing purposes. Bore a ¼-in. hole through the block, and square it out as shown at B; this is to take the wedge W (Fig. 2) which holds the file F in position. The square hole should be slightly tapered, so that the wedge can be easily released. Run a saw kerf straight through the block B down to the slot, as shown at C (Fig. 1). The kerf should be just wide enough for the scraper S (Fig. 2) to slide freely; then a few rubs backwards and forwards will produce an edge which cannot be otherwise than square with the face. It is somewhat difficult for the novice to hold the scraper perfectly upright, so as to prevent it from swaying from side to side on the oilstone whilst setting up the edge. A block something similar to Fig. 1 could be adapted for holding the stone, or even a square piece of wood might be held on the oilstone to act as a fence for the scraper; this at least would preserve the squareness of the edge. It is when the scraper becomes too dull and rounded on the edges by repeated applications of the "steel" that the edge requires to be turned over to an acute angle with the face. The proper instrument for turning over the edge of a scraper is a currier's "steel," which is a hard-tempered and highly burnished little tool. Lay it flat on the bench, with the edge projecting ¼ in. or so; hold it firmly to keep it from shifting; grasp the "steel" with the right hand, handle downwards, and work it along the edge. The "steel" should be held almost perpen-



Sharpening a Cabinet-maker's Steel Scraper

dicular: an angle of 80 degrees is about right. When the edge of the scraper is turned over in this way, the edge of the work bench forms a guide for the hand which holds the "steel," so the operator has the assurance that the edge of the scraper is turned over to a regular and certain angle. The proper amount of pressure to be used can be ascertained only by trial; some scrapers require more force than others on account of their difference in temper. A coarsely turned edge only works in fits and starts, and is apt to leave the work with a lumpy finish; therefore, when turning the edge, do not give the steel too much angle. After trueing and setting, the edge should be as keen as a razor. Many fail to get a good edge on the scraper through trying to turn over the edge when holding the scraper edge upwards on the bench.

Repolishing a Bath Top.—Scrub off the polish with strong washing soda, using a little powdered pumice stone or Bath brick to assist. When dry, smooth down with glasspaper. Bath tops are usually French polished with a trace of red in the polish to make them look rich in tone. If this is done, and the surface left perfectly free from grease, and afterwards given an even coat of best quality oil varnish as used by house painters, a good wearing surface will be secured. If unable to French polish, fairly good results may be obtained by the use of a combined mahogany stain and varnish, as sold at paint stores, but a good quality oil varnish must be used afterwards.

Wheelwright's Horse for Mortising Wheel Naves.—The horse shown in Figs. 1 and 2 is to be preferred to the pit for light work. It stands close against a wall, preferably under a window; the larger parts can be made of deal. It is very light, and can easily be removed if desired. In Fig. 2, A shows the front of top of wheel horse and B the back, each being 4 in. square; C D are the legs, 3 in. square; E E are two pieces connecting front and back of horse together, 2½ in. wide by 1½ in. thick. These are driven tightly into a mortise about halfway through B and pegged or screwed; the other ends fit fairly tight in a mortise going right through A, so that the whole front of horse, with legs, can be knocked backwards and forwards to accommodate hubs of different lengths. Two pieces F F, 2 in. square and 19 in. long with ½-in. bolts, are nailed or screwed on top of wheel horse and hollowed out on top for nave to rest in. To strike a curve on front piece, open the compasses 2½ in., and for back piece 3 in. The nave is fixed with pieces of iron about 1 in. wide and ¼ in. thick, dropping loosely over the bolts and spanning the nave at front and back, which they are bent to fit. A frame for a pit for making very heavy wheels would have to be a fixture; the front might be 7 in. wide in the centre, and taper on the inside to 3½ in. at ends, thus forming a bow piece to allow for the dish of the wheel. The timber for making the pit frame shown in plan, Fig. 3, should be 3 in. or 4 in. thick, the pit being 2 ft. 6 in. deep.

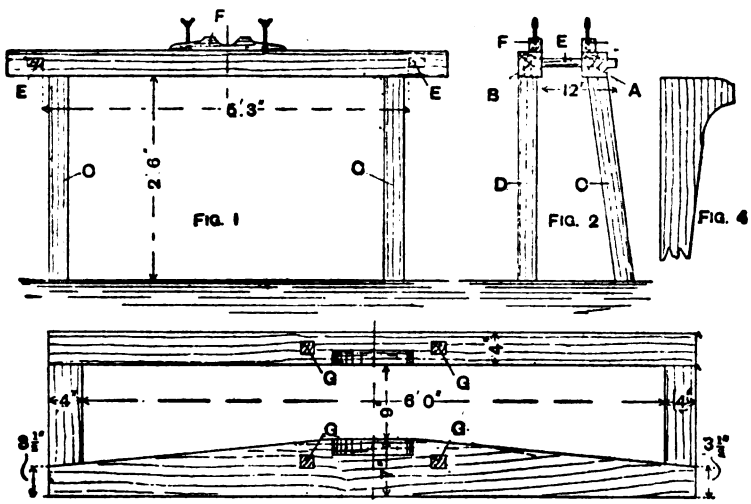


FIG. 3

Wheelwright's Horse for Mortising Wheel Naves.

The four mortises G are 1¼ in. square, and the ground should be cleared away underneath them so that the pieces shaped like Fig. 4 (which are about 22 in. long, 1¼ in. thick, and 4 in. wide at the top) may be knocked back from below. The inner surfaces of these holding pieces should be shaved out on the bevel, so that when driven in they come into close contact with the sides and top of the hub, thus holding it in place. These pieces (Fig. 4) take the place of the four thumbscrew bolts of the wheel horse.

Fitting a New Hairspring to a Watch.—It is first necessary to know how many beats per hour the balance is required to make. This varies according to the kind of watch. A Geneva or an American watch will beat 18,000 per hour; an English watch may beat 14,400, 16,200, 18,000, or some number between. In an English lever, if the fourth wheel has ten times as many teeth as the 'scape pinion has leaves, the train is 18,000; if nine times as many, it is 16,200; if eight times as many, it is 14,400. A watch with an 18,000 train beats 15 double vibrations per minute, and so on. The number of beats per minute of a watch balance when keeping correct time may be anything between 240 and 300. Watch trains are calculated as so many beats per hour. Thus, a watch beating 240 per minute is said to have a 14,400 train, and one beating 300 per minute has an 18,000 train. To ascertain the train of any watch, multiply together the numbers of the teeth in the centre, third, fourth, and 'scape wheels. Also multiply together the numbers of the leaves of the third, fourth, and 'scape pinions. Divide the first product by half of the second product, and the result is the number of beats per hour. Thus, centre wheel has 60 teeth; third wheel, 60; fourth wheel, 54; 'scape wheel, 13; third pinion, 8; fourth pinion, 6; 'scape pinion, 6. Then $60 \times 60 \times 54 \times 13 = 2{,}527{,}200$; and $8 \times 6 \times 6 = 288$. Therefore, the train $= 2{,}527{,}200 \div \frac{288}{2} = 17{,}550$. Select a hairspring of about the required diameter to suit the regulator pins, or a little larger, and lay it in position on the balance, pushing the brass hairspring collet down tightly upon it to hold it temporarily in position. Then hold the outer end of the spring in a pair of tweezers, and lift up the balance, just allowing the lower pivot to rest upon a watch glass. In this position, give it a rotary motion, as in the watch, holding it as steady as possible. When once started, the balance will continue to vibrate backwards and forwards for more than a minute. Have at hand a watch with a seconds hand, and carefully count the double vibrations in a minute, or, for a preliminary trial, in twenty or thirty seconds. If the trial spring is too slow, try a stronger one; if too fast, try a weaker spring. Be careful to hold the spring in the tweezers at the point where it must be pinned into its stud, as a spring that is too large for the watch must have several complete turns broken off before using, and in such a case must be held in the tweezers for counting several turns from the outside end. By repeated trials, select a spring that, when held at the required diameter, counts the correct number in a full minute. To pin it into its collet, put the collet on a broach and hold in the hand; cut out the inner coils of the spring until the collet will easily pass through; then bend the inner end sharply inwards to pin in the collet. To cut out the centre, lay the spring on a watch glass and, holding the inner coil with a fine pair of tweezers, break off about one-third of a turn at a time until it is correct. When properly cut out, and the end bent inwards, pass the hairspring over the broach upon which the collet was placed, and insert the bent-in end for pinning. File up a smooth brass pin to fit, flat it on one side (to go against the spring), try it in the hole before cutting off, and half cut it through with a knife; then insert it, and break off, afterwards pushing it home with the tweezers. Then see that the spring is flat as it stands upon the broach, and revolve the broach in the fingers to test it. If flat, take it off the broach, lay it on a watch glass, and see that it is true to centre—that is, that the collet occupies the exact centre of the spring, and that the spring starts away from the collet freely, and does not "hug" it. Then put it on the balance, and again count it for a full minute, trying it repeatedly until a point is found at which, when held, it counts *one beat* per minute too slow. This is the point at which to pin it in its stud. Then try in the watch, and if too slow, as it will be a trifle, shorten it until correct. It is always best to pin them in a little slow at first, and shorten till right, as, if the spring is once made too short, it cannot again be lengthened. When finished and in the watch, be careful to see that the spring lies quite flat, and is free of the balance arms and the balance cock; that its outer coil passes freely between the curb pins of the regulator, and plays between them nicely; and that the second coil does not touch the stud or the inner curb pin, and in a Geneva watch be careful that the outer coil never touches the centre wheel.

Stain and Varnish for Towel Rail. — Towel rails are usually finished in imitation pine or mahogany. For pine, mix a small quantity of raw sienna with stale beer or vinegar; apply with a brush, rubbing well into all quirks, and wipe off the surplus with clean rag. For mahogany, use burnt sienna. When dry, rub smooth with coarse rag or fine glasspaper. Then coat several times with spirit varnish applied with a camel-hair brush. A more intense red may be gained by adding one pennyworth of Bismarck brown to each pint of varnish. A suitable varnish consists of methylated spirit, 1 pt.; shellac, 4 oz.; resin, 2 oz.; and gum sandarach, 2 oz. Dissolve in gentle heat, and carefully strain.

Mitring a Cornice Moulding.—The method of mitring the cornice moulding shown by Fig. 1, when the cornice is built up as shown by the section (Fig. 2), should present little difficulty in respect of the members A and B. To keep the moulding in position whilst cutting the mitre of C, place a strip of wood E in the mitre box (Fig. 3); the distance from the edge of this to the back of the box must be equal to D (Fig. 2). For ordinary purposes, mitres made direct from the saw without shooting are suitable; the saw must have but little "set," and the mitre box must be true. Should easing be necessary, use an iron face smoothing plane set fine. In more important work where the mitres have to be shot, a screw mitre shoot will be found very useful. A simple form of shoot can be made by nailing together four pieces of prepared wood and carefully mitring the end, as shown at Fig. 4, in which the moulding can be firmly held while it is being shot by a couple or more screws going through the box into the back and top of the moulding, as indicated at G and H (Fig. 4).

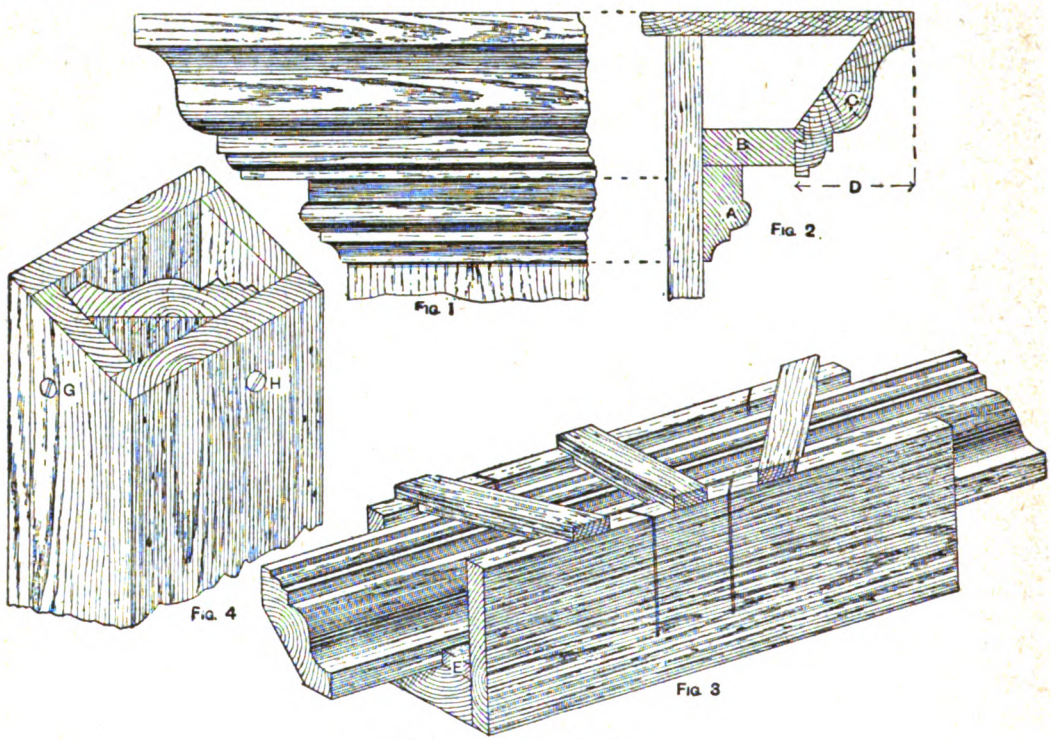


Fig. 1. Fig. 2. Fig. 4. Fig. 3.

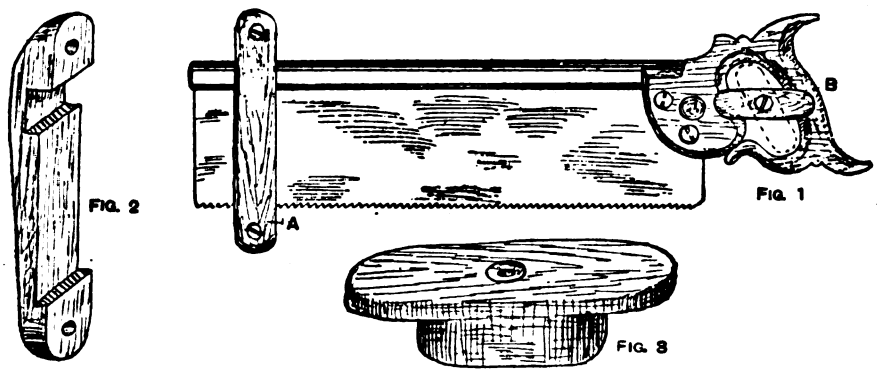
Mitring a Cornice Moulding.

Making Indiarubber Tubing. — There are two methods of making rubber tubing. The pure rubber is treated with carbon bisulphide or benzine to form a dough, which is rolled out into thin sheets and then cut into strips. A strip is rolled round a cylindrical mandrel the diameter of the tube required, the superfluous edges are cut straight along, and the freshly cut edges touched with rubber solution and pressed together. The rubber is now cured either by soaking for the requisite time in a solution of sulphur chloride in carbon bisulphide, or by heating in a mixture of French chalk and sulphur to a temperature of about 140° C. The mandrel can afterwards be withdrawn. Wired tubing is made in the same way, the wire serving in place of the mandrel. Some tubing is made by kneading between steam-heated rollers the uncured rubber with sulphur and inert materials, such as zinc oxide, French chalk, etc., and forcing it through a hole in a die in which is a plug the same diameter as the tube. The rubber tube is drawn away as fast as it is formed, then placed in French chalk and heated to 140° F. The core of catheters and similar things is an iron wire, which is withdrawn after curing.

Making Photographic Carbon Tissue. — Carbon tissue may be purchased either sensitised or unsensitised. Sensitised carbon tissue will keep for a fortnight, under pressure; unsensitised tissue will keep indefinitely. To sensitise the tissue, immerse it in a solution of bichromate of potash, and let it dry squeegeed in close contact with glass. This operation is conveniently performed at night, when, if the room is kept fairly dark, the glasses may be placed in the rack over the kitchen fire; in the morning they will be dry. Care must be taken to dry the tissues away from gas or oil fumes, as these make the tissue insoluble. Many good authorities, however, consider that better results are obtained when the bichromate is mixed with the gelatine before coating the paper. The following is Burton's procedure:—Cover 4 oz. of Nelson's opaque or other soluble gelatine with 15 oz. of water, and allow it to swell for an hour or so; then thoroughly dissolve by placing the jar containing it in hot water. Dissolve 1½ oz. of loaf sugar in 2 oz. of water and add to the dissolved gelatine. Next dissolve ½ oz. of potassium bichromate in 3 oz. of water, and add to it sufficient ammonia to give it a decided odour; then mix with the gelatine. The favourite pigment is Chinese ink, but any pigment in a very fine state of division is suitable; it should be broken up, and made into a stiff paste with water. Mix some of this pigment thoroughly with the gelatine in small quantities, stirring vigorously, until more pigment has been added than is necessary to render quite opaque a thin film spread on paper. The support must be a good tough paper that will stand rough handling when wet. Over the top of a trough is then fixed a large glass rod or tube. Two sheets of paper are placed back to back, and, one end being brought under the rod, the solution is poured out until it half covers the rod; by gently drawing the paper round the roller the two outside faces are coated. Hang up to dry, and the paper is then ready for use.

Making Watch Hairsprings.—The operation of making watch hairsprings requires special skill. In making by hand, flat wire is fastened at one end to the arbor of a winder not unlike a mainspring winding tool and wound up quite tight, and kept flat by a brass guide on each side like a bobbin. When wound singly and released, the spring will open out a trifle only, and the finished spring is a "close-coiled" one. But when two or three wires are wound up one over the other, the results are more open in the coils. The best hairsprings are afterwards fire-hardened and tempered, but common ones are left soft. They are hardened by being heated to redness in a box specially made to exclude the air, and then plunged into oil or water. They are tempered by being heated on a metal plate until a slip of bright steel placed beside them turns to a full blue. They are then polished by means of rouge and oil on a peg or wood polisher (this is very delicate work), and afterwards "blued" by heat on a metal plate over a lamp flame. These fire-hardened hairsprings are expensive, but are always used in the best watches.

Fastening Tenon Saw to Lid of Tool Chest.—A simple method of fixing a tenon saw on the lid of a tool chest is to use a wooden clip, as shown at A (Fig. 1), which holds the end of the saw. The handle can be fastened by a button, as shown at B. When the button is moved to the position shown by the dotted lines, it will allow of the saw being taken out. Figs. 2 and 3 are enlarged sketches of the clip and button respectively.



Fastening Tenon Saw to Lid of Tool Chest.

Recipe for Dead Black Waterproof Ticket Ink.—Take ivory black or any dry colour and grind (on a slab with a muller) in japan gold size to the consistency of honey (the proportions cannot be given, as one colour will absorb more size than another colour). Now spread the colour on a piece of stout blotting paper, and let it remain for about an hour; this will extract the grease from the gold size. Collect the colour in a pot and thin with benzine, as the latter evaporates quicker than turps, leaving a better flat.

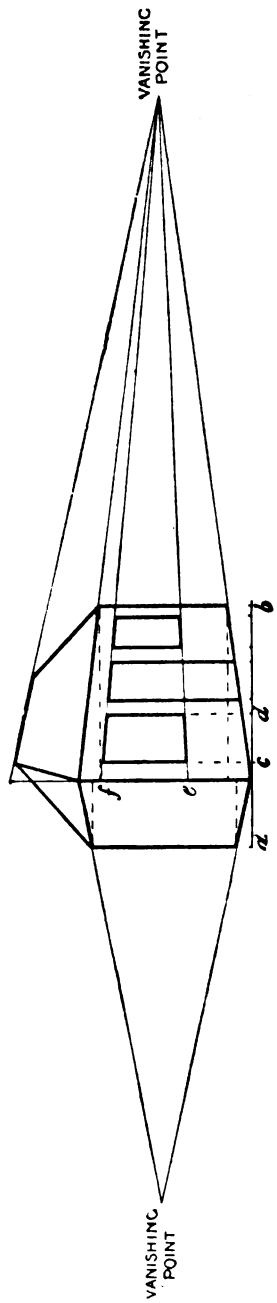
Preparing Scenery for a Diorama.—The kind of cloth used for dioramas is called union; it is made in various sizes, and requires no preparation to receive the colours. The subject to be represented is first carefully drawn in outline with a pencil. Then mix some vandyke brown with hot double size, and with a fine brush go over the pencilled outline. When thoroughly dry, the painting of the picture may be proceeded with. Jelly size is the medium, about 1 qt. of water to a pound of size. Only transparent colours should be used, such as azure blue, celestial blue, indigo blue, damp lake, brown lake, Dutch pink, raw sienna, burnt sienna, Indian yellow, Indian red, vandyke brown, ivory black, blue or sky colour. Break up some whiting and cover with water. Take as much azure blue as is required for the sky colour, and make it into a paste with water, adding just enough whiting to make the blue flow evenly; the colour should be semi-transparent. Cover the whole of the picture with this colour, commencing at the top and working downwards. As the work proceeds the colour should be thinned with the medium, so that there may be a gradual change of tint from dark to light. All illuminated parts must be thinly covered. When this is dry, give the other portions of the picture their local colouring, and finish off. If the other side of the picture is to represent moonlight, draw the moon with a fine line and slightly tint it with appropriate colour. For the dark parts of the sky, use celestial blue; for the dark clouds, indigo; and for very dark clouds, sadden with black. All trees and foliage should be treated in the same way; the buildings, etc., should be covered with a deepened local colour, especially in the dark parts and shadows. Windows and illuminated parts should be covered with Indian yellow for yellow lights, and with lakes for red lights such as a fire. The dioramic change is made by gradually turning down the light in front and turning it up at the back. The stronger the light the better will be the effect.

Making Cyanide of Potassium.—Prussian blue, ferrocyanide of potassium (yellow prussiate), and cyanide of potash are now recovered by the Gas Light & Coke Co. from the purifying materials used. There are two methods of recovering the cyanogen compounds: the first by absorption in the scrubber, the second by absorption in the oxide purifiers. In the first method a scrubber is used containing soda or potash and some suspended oxide or hydrate of iron; the cyanogen in the gas combines with the iron and alkali to form ferrocyanide. If the iron is in excess the compound is insoluble (probably as Prussian blue), but if the iron is not in excess, then the compound is soluble. After a certain period the liquid is run off for concentration. In the second method the cyanogen is fixed in the oxide of iron purifiers as Prussian blue (ferric ferrocyanide). By leaving one oxide purifier as No. 1 in the series long after it has become saturated with sulphuretted hydrogen as much as 8 or 10 per cent. of Prussian blue has been obtained from it. The oxide of iron is exposed to air in the usual way to revivify, and the sulphur extracted by carbon bisulphide in closed vessels; the sulphur is recovered, and the carbon bisulphide used over and over again. The spent oxide is boiled with lime and water, when the Prussian blue is decomposed and ferrocyanide of lime is produced. The clear solution is drawn off acidified, and a per and proto salt of iron added yielding a pure Prussian blue, which is allowed to settle, washed, collected in bags, filter pressed, and dried. From this pure ferrocyanide of potash is produced by boiling with the calculated equivalent of caustic potash. Cyanide of potash is formed by fusing Prussian blue or ferrocyanide of potash with the right proportion of carbonate of potash.

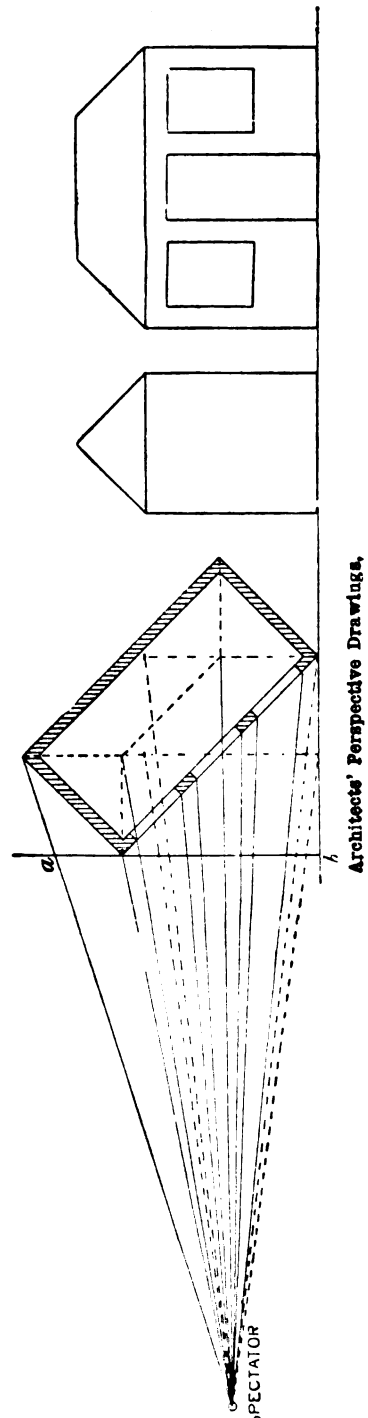
Sizing and Varnishing Wall-paper.—To size and varnish the paper of a hall and staircase, dissolve 7 lb. of size in 3 gal. of boiling water. When cold it will be of the consistency of a weak jelly. Apply this to the paper with a double-knot distemper brush, being careful to go over every bit of the paper. Twelve hours after, apply a second coat of size. Twenty-four hours after the second coat has been applied the paper will be ready for varnishing. A good paper varnish may be made by well mixing ½ gal. of pale oak varnish, ½ gal. of turpentine, and ½ pt. of raw oil. If the weather is frosty, the staircase and hall should be heated to about 60° F. If this is not practicable, wait until the frost disappears. Spread the varnish with a hog's-hair varnish brush, commencing at the top, and working evenly downwards. A second coat of varnish six months after the first has been applied would make a first-class job.

Preventing Oxidation of Molten Lead.—Strew powdered charcoal over the surface of the metal; or add borax, which will fuse and form a layer upon the lead, thus excluding the atmosphere. The brown powder is largely oxide of lead; it may be reduced by mixing with finely powdered charcoal and a little borax and raising to a red heat; from it the lead which it contains can thus be recovered.

Architects' Perspective Drawings.—The perspective drawings prepared by architects sometimes have the principal lines put in by the rules of geometrical perspective as taught in the art schools, but usually they are found by a special method shown in the accompanying diagram, where a very simple building is chosen to indicate the course pursued. The drawings



being often on separate sheets, the plan is first fastened down on the table by drawing-pins. A suitable point of view is then selected, and a common pin stuck in to represent the spectator. A narrow strip of paper is now fixed by two drawing-pins, and a line ruled upon it in the position chosen for the transparent plane, or picture plane, which should touch the nearest angle of the building, and a straight-edge is used to mark lines across the picture plane from the pin to all the chief angles of the plan, as on line *a b*, writing the names against the chief ones so as to know one from the other. A line representing the ground line is then drawn below



Architects' Perspective Drawings.

the position of spectator, as if the view were a section, vertical lines drawn from the corners of the building, and the heights of the angles set off above the ground line. Dotted lines are now drawn from the extremities of these to the pin, cutting the picture plane in the

points marked. Now, for the perspective, take a clean sheet of paper, and fasten it down on a drawing-board, pin the strip of paper *a b* horizontal near the bottom edge, and project vertical lines from the points which represent the angles of the building. Decide where the bottom of the nearest angle in the perspective shall be, and above it set off the heights where the dotted lines crossed the picture plane, measured from *b*, and from them draw horizontal lines to intersect vertical lines drawn from *a b*. Join the intersections, and the two visible sides of the house will be obtained. Produce these to intersect on each side, and the two vanishing points will be found. For the remainder draw vertical lines from any given points on *a b*, such as *c d*, set up the height of the parts on the front angle of the perspective, such as *e f*, place a straight-edge from these points to line with the vanishing point, and the intersection with the vertical lines will give the required perspective. Geometrical perspective is useful as giving a scientific foundation and reason for the appearances of objects of all kinds when viewed naturally by the eye. Ordinary drawings of buildings and details are merely conventional representations, and although they may be looked upon as flat models, and are most useful, they do not represent things as they are seen. Architects' perspective is an empirical or "rule of thumb" method suited to the circumstances, but not available as a basis for the general study of the subject.

Medicine Cupboard.—Fig. 1 shows a front elevation and Fig. 2 a side elevation. It is 2 ft. long and 17 in. wide, and is fastened to the wall by four mirror plates, one at each corner. The four shelves are let into the ends about $\frac{1}{8}$ in. by sawing two gates and cutting out with a

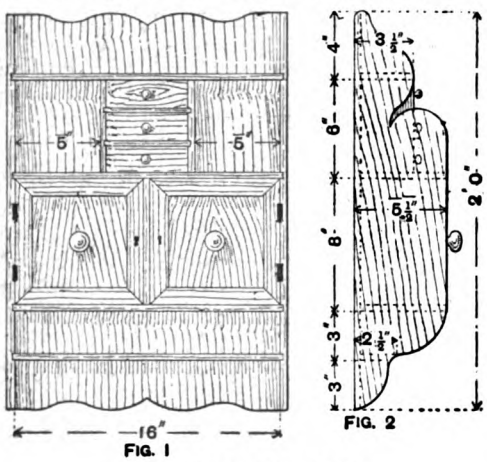


FIG. 1 FIG. 2

A Simple Medicine Chest.

narrow chisel. The doors have imitation panels made by mitreing strips, chamfered at the edges, of a plain door 1 in. by $\frac{1}{4}$ in. The piece sawn out of the top is fastened to the edge of the top shelf. The bottom shelf is rounded at the corners to bring it to the width of the end, as it is narrow where the bottom shelf goes. The ends are of $\frac{1}{4}$-in. wood, the shelves of $\frac{1}{2}$-in. wood, doors of $\frac{1}{4}$-in. or $\frac{1}{2}$-in., and the back of $\frac{1}{4}$-in. wood. A button on the partition will do instead of locks.

Waterproofing Van Sheets.—A waterproof paint for van sheets may be made by boiling together, at a temperature of 500° F. for four or five hours, 1½ gal. of linseed oil, 2 oz. of litharge, 2 oz. of umber, and just sufficient vegetable black to colour it. Another paint is made from 1 gal. of boiled linseed oil, ½ pt. of japanners' gold size, 1 lb. of vegetable black, and 1 lb. of best patent driers. The sheet should be laid upon a table and painted with either of the above paints, dried in the open air for several days, then again painted and dried.

Disinfecting Books.—If the book to be disinfected is not of much value, burn it. A valuable book may have each page dipped in a solution of bichloride of mercury, blotted and dried, the covers removed and burnt, and the book rebound. Or the book may be passed through a hot-air disinfector, the pages being opened so as to allow the hot air to pass between them; and probably the book will have to be rebound. A steam disinfector is equally effective, but the book will be more damaged than by hot air, and the covers will be completely ruined, making rebinding a necessity. At Sheffield, a disinfecting apparatus is in use in connection with the free library, the books being placed in a closed chamber in which carbolic acid is vaporised by heat, which it is claimed makes the carbolic acid more potent and active; the vaporisation takes place at 80° F., the vapour being raised to about 200° F., and the books being subjected to this process for about fifteen minutes. It is also stated that books can be disinfected in fifteen minutes in a closed space simply by formaldehyde vapour (or vapour of commercial formalin) by using 1 cub. centimetre of formalin to 300 cub. centimetres, or less, of air. The books may be placed on their ends, but the better plan is to hang them up; the covers are opened out until they touch each other, and are fastened together, being suspended from the fastener; by this means all the leaves are slightly separated, and free access for the hot air, steam, or disinfecting vapour permitted. They should never be placed flat. These methods are equally suitable for typhoid germs as for tuberculosis.

Reviving Polish on Pianos.—Take equal parts of lime water, raw linseed oil, and turps. Well shake the lime water and oil till a cream is formed, then add the turps. Apply liberally with wadding, and wipe off with rag. Clear out all greasiness, and bring up the polish by means of a clean rag made fairly moist—not wet—with methylated spirit. Repeat if required. Should there be any peeling off by reason of the paste already on, wash off with 2 gal. of warm water, to which has been added a teacupful of common washing soda.

Bed-rest for Invalid.—A simple form of back-rest suitable for an invalid when sitting up in bed is

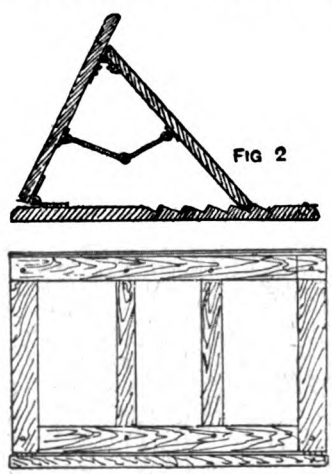


FIG. 1

Bed-rest for Invalid.

shown in the accompanying sketch. For its construction good red deal, birch, or mahogany may be used. Make three frames similar to Fig. 1, the outer edges being rounded. These three frames are hinged together as shown at Fig. 2, the back frame having a slanting edge to fit into the notches of the bottom frame. A pair of iron or brass hinged stays, fixed at the sides, will prevent the sliding back from slipping.

Lacquering Brasswork.—To relacquer fire brasses, curbs, etc., have them perfectly free from grease, and heat them on a hot plate of some kind, and when hot enough apply the gold lacquer with a camel-hair brush; then place them on the hot plate again for a short time. Take the articles off and allow to cool; do not touch them while hot with the fingers.

Polishing Teak to Resemble Rosewood.—To stain and polish teak to represent rosewood, dissolve one pennyworth of Bismarck brown in 1 pt. of hot vinegar and water (equal parts). With this, brush over the article once or twice. When dry, wipe over with "red oil," which is made by steeping 2 oz. of alkanet root in ½ pt. of raw linseed oil. The work is then ready for polishing. As teak is a hungry wood, to gain good results a grain filler should be used. Mix finely crushed dry whiting into a creamy paste with turps, colouring it to match the wood by adding venetian red and vegetable black or lampblack. Rub well in in order to fill up the grain. Wipe off clean, leaving the surface of the wood free from paste, and polish in the usual way, adding Bismarck to the polish to give a reddish tinge; if a darker tone is desired, a trace of black may be added.

Erasing and Re-engraving Initials on Watch Case.—To erase initials from a watch case is a delicate job. If the letters are in the centre of an otherwise plain case, take a fine flat file (costing about 4d. at a jewellers' material dealer), and, with short, firm strokes, file out the letters. Then go over the surface with a piece of snakestone or Tam-o'-Shanter hone, and finish with putty powder on a piece of soft leather. If the letters are in a small shield, the tendency is to damage the outside work, which would require to be re-cut. With a small riffler, or bent file with a flat surface, file out the letters, dress with snakestone fashioned to a point, and finish as described above. If new initials are required, first draw them in pencil, and scratch them on with a point or etching needle. Then whet up a graver at moderately sharp angles, outline lightly, put in the thickening cuts, relieve the whole with light and graceful sprigged work, and then clean up.

Combined Jewel, Glove, and Handkerchief Case.—A case made in the form of Fig. 1 will be suitable for holding jewels, gloves, and handkerchiefs. It is 14in by 8in. by 9in. deep, and contains two drawers, one to receive handkerchiefs and one to receive gloves. The upper part is fitted with a tray to lift out; this is to hold jewellery. Figs. 3 and 4 are plans of the two drawers. Fig. 2 is a plan of the tray; the centre part A is movable, and is arranged to hold a watch, the latter lying on a cushion formed on a piece of

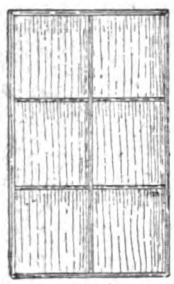


Fig. 4

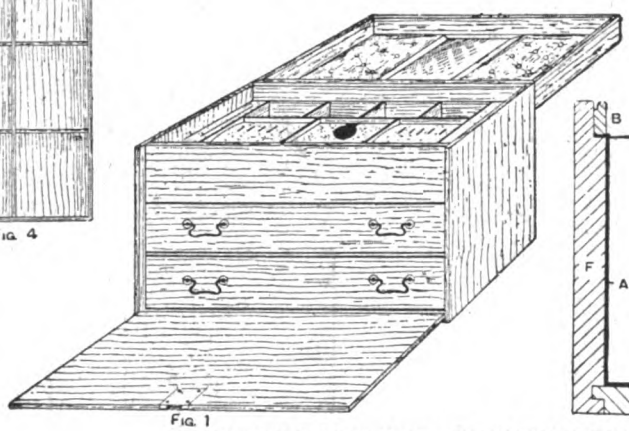


Fig. 1

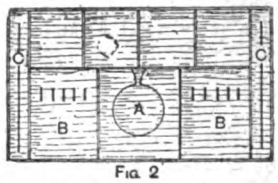


Fig. 2

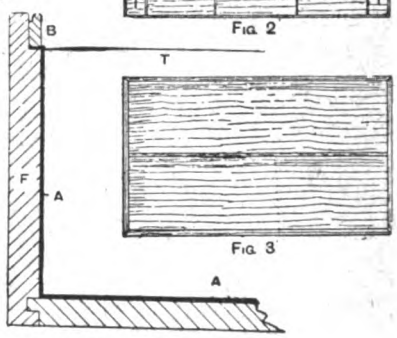


Fig. 3

Combined Jewel, Glove, and Handkerchief Case.

¼-in. wood. The part at the back is left open to allow the watch chain to fall into the drawer or box underneath the cushion. The back part of the tray is fitted with four compartments to receive trinkets, etc.; the side parts marked B, with ribbon loops, are for pins, brooches, etc.; the sides marked C are slotted to receive rings, etc. The whole of the interior is covered with velvet plush, the inside of cover of the case is fitted with a bevelled mirror, and the sides are lined with plush, and buttoned. If a smaller case is required, make a box in the ordinary manner, and fit it with a tray as Fig. 2, omitting a compartment in length. To line the drawers of the glove box rebate the inner upper edge of the drawers as shown in the accompanying sketch, and after fixing the lining A, fix in the bead B. T is the top edge of the division and F the front of the box. The divisions should stand lower than the upper edge, and in covering, the lining should be stretched over the top edge, the raw edges being carried to the bottom. Glue, if used thick, will not spoil the pile; if used in a thin state, the glue will percolate through the foundation, and so spoil the velvet.

Hints on Printing Blue Photographs.—The details of the picture should be fully out, and the dark parts should have a bronzed appearance. Care is required to prevent the blue becoming less intense, and therefore the white lines not showing up so much. A print too much exposed appears weak, but the same occurs with too little exposure. The ferricyanide used should be as pure as possible. It is affected by air and light, which may change it into ferrocyanide. The first forms a blue precipitate, and the second a white. Crystals of ferricyanide should therefore be rinsed before use to rid them of the changed outside covering. The first washing water should be acidulated with hydrochloric or citric acid. This tends to improve and retain the brightness of the image, by dissolving out the remaining iron, and preventing the deposition of a white precipitate over the blue. It is very desirable that the paper should not in any case be washed for a lengthy period.

Tinning Inside Copper Pipes and Brasswork.—For tinning any metal it is first necessary to clean it from dirt and sand and remove the surface which is oxidised or tarnished. This surface is removed by pickling the metals for a few hours in clean water containing a small quantity of sulphuric acid. The metals are then dipped in chloride of zinc, and afterwards laid in a bath of molten tin, out of which they are taken and held up for the surplus tin to drain off. It is doubtful whether this process is entirely satisfactory for artificial mineral waters, as the so-called tinned surface partakes more of the nature of an alloy of tin and zinc. Unless the proper appliances are at hand, it is cheaper and better to buy the copper pipes already tinned. It is also probable that white-metal cocks or taps would answer equally as well as those made of brass, which would have to be tinned before being ground in.

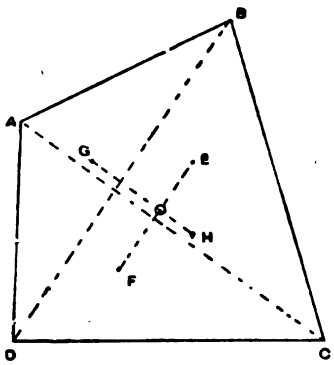
Contents of Tapering Vessels.—A gallon of water occupies 277·27 cub. in., and the capacity of the frustum of a cone can be obtained by adding to the sum of the areas of the two ends the square root of their product and then multiplying by one-third the vertical height. The contents will be in cubic inches if the areas and heights are measured in square inches and inches respectively. Of course, there are many varieties of tapering vessels that will hold 1 gal., but, assuming that the diameters are 3⅞ in. and 4¼ in. at bottom and top of the vessel respectively, the height can be determined as follows:—The areas of the two ends will be $3\frac{7}{8} \times 3\frac{7}{8} \times \cdot 7854 = 10\cdot3$ sq. in., and $4\frac{1}{4} \times 4\frac{1}{4} \times \cdot 7854 = 14\cdot2$ sq. in. respectively; the product of these is about 144, its square root being twelve. The sum of the ends, etc., is therefore $10\cdot3 + 14\cdot2 + 12 = 36\cdot5$, so that the height should be $3 \times \frac{277\cdot27}{36\cdot5} = 22\cdot7$ in. (say).

Etching on Copper.—A copper plate is polished, and fixed in a mixture of resin and beeswax by warming the wax and laying the copper plate on. All grease is removed with whiting, the surface of the copper coated with fine wax, and the pattern drawn with a fine etching needle passing through the wax to the copper. Nitric acid is then applied to the surface; this eats into the copper plate where pricked with the etching needle, the wax preventing the acid from biting in places not required. When sufficiently bitten in, the plate is removed, the wax warmed and pulled carefully off, and the plate cleaned with turpentine.

Making Night-lights.—Night-lights are made by melting the material and pouring it into metal moulds in which the wicks have been previously placed. The commoner night-lights are made from paraffin wax, whilst the better ones are made from stearin (the fatty acids which are obtained from tallow or palm oil by saponification and pressure); or from composite, a mixture of paraffin wax or cerasin with stearin (*glyceryl tristearate*).

Copying a Mounted Photograph.—The print should be copied in contact with glass. Presuming the print is upon an ordinary mount (that is, not set back in a cut-out mount), place it in a frame containing a perfectly clear sheet of glass, and press into close contact. Set up the frame facing a full light, care being taken to avoid reflection by covering up objects that are reflected in the shadows of the picture. If a studio is not available, the copying should be done out of doors in full sunlight, in which case it may be possible to avoid grain without copying under glass. Slow plates are the most suitable, but much depends upon the degree of contrast in the print, the printing process to be used, etc. For example, if the copy is very hard, and the picture is to be printed upon P.O.P., use a quick plate and the usual developer. If, on the other hand, the copy is flat and wanting in contrast, and the negative is for printing in carbon or for reproduction, use a process plate and hydroquinone developer.

Position of Mast in Canoe.—The centre of effort of a single lug-sail should be about 3 in. ahead of the centre of lateral resistance of the immersed portion of the canoe's hull; the correct position of the mast will therefore depend on the position of the centre board, if any, or the shape of the keel, neither of which is given. The centre of any triangle's area is the point at one-third of the line from the centre of any side to the opposite angle. Hence, if the sail be divided by line A C (see sketch) the points E and F will be the centres of triangles A B C and A C D respectively. Join these points by line E F. Again divide the sail by the line B D, find G and H the centres of triangles A B D and B C D; join G and H, which line intersects E F at P, the "centre of effort" of the sail. To ascertain the centre of resistance,



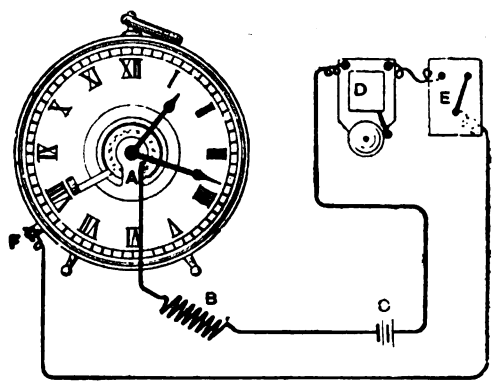
Position of Mast in Canoe.

let down the centre board, place the rudder amidships, and let the crew on board hold one end of a string in such a position that when the other end is steadily pulled by a second person, the canoe will approach the latter, remaining at right angles to the string. Mark this position, and step the mast in order that the sail's centre may be 3 in. or 4 in. ahead of it measured horizontally. The rudder stock must not extend below the keel, but the drag may be curved to 4 in. below it and extending aft to 10 in. A nearly vertical stern-post is advisable.

Power from Waterfalls, Tides, etc.—The different methods by which water can be made to perform mechanical work are: First, by its weight; second, by shock, as when a stream of water impinges at right angles on a moving surface; third, by action or impulse, as when an unconfined stream of water meets a moving surface, the relative velocity having no portion at right angles to the surface, but gliding along and ultimately leaving the surface; fourth, by reaction, as when a stream of water enters, flows through, and ultimately leaves a moving pipe or channel, which it completely fills; and fifth, by a combination of two or more of the above methods of action. The classification of the motors may be as follows: (*a*) Water wheels (the water acting on the outside of the wheel) are either undershot, breast, or overshot wheels; (*b*) turbines (an arrangement where the water acts through the inside of the wheel) are either on the axial or the radial flow system, and may work either by reaction and impulse combined or by pure impulse alone. Water power is useful for any industry requiring slow-moving, regular power, such as corn-grinding, ore-crushing, chemical mixing, etc. Tide motors may be on two systems: in the former, the tidal waters rush through a small opening into a reservoir, actuating a turbine which is fixed in the opening, and the ebb water rushes out through another opening (the first opening being closed by a penstock or shutter) actuating another turbine. The cost of the reservoir, which is practically a tidal dock, is very great. In the other system, a series of wooden gates hanging from a frame are set in motion by the rise and fall of the waves, and their motion is conveyed by cranks and rods to an engine. Tidal motors, especially the latter form, are only available for purposes not requiring regularity, such as pumping water for keeping a reservoir replenished.

Rubber Solution for Patching Mackintosh.—Rubber solution must be made from indiarubber which has not been vulcanised; Para rubber is considered best for the purpose. The rubber should be cut into thin shavings with a very sharp, wet knife. The shavings may be dried, then placed in a dry, wide-mouthed bottle, and covered with benzene (coal-tar naphtha) or carbon bisulphide. Benzene is preferable, as it does not smell quite so strong as carbon bisulphide. The bottle should be tightly corked, placed in a warm place, shaken from time to time, and more solvent added as the rubber swells. One ounce by weight of rubber will take from 15 oz. to 20 oz. by measure of the benzene. This solution will be found suitable for patching a mackintosh or for use in places where rain penetrates, but as a dressing for re-waterproofing it will not stand.

Electric Alarm Device for a Clock.—The diagram below shows how to attach an electric bell to a clock, the bell to ring at any given time. A is an alarm device cemented to the face of the clock. The flexible wire at B is connected to the battery at C, and thence to the bell D and make and break switch E. The terminal connected to the pivot of the switch may be connected



Electric Alarm Device for a Clock.

to a terminal F fastened on the clock case. Thus a complete circuit is formed with the whole of the apparatus in series.

Polishing Tarnished Copper.—The quickest and cheapest method of polishing tarnished copper is to buff up the article on a polishing machine; if this is impracticable, it may be polished by hand. To do this, mix some fine flour emery with sweet oil until a thin paste is formed, and, using a piece of house flannel as a pad, scour the tarnished surface with the paste until the surface is quite clean. Wipe off the oil from the copper, and with a dry piece of flannel dust the copper over with crocus powder, and polish with this until quite bright.

Painting Canvas Canoe.—Both sides of the canvas material of the canoe should be painted. The object in painting the inside is to prevent any water getting between the framework and the skin and thus rotting the canvas. Particular attention must be paid to all inside corners and edges of the stringers; the frame also must be painted before stretching the skin. There is nothing better than ordinary paint, but see that the white lead is good and not half whiting. Use plenty of boiled oil for the last coat, as salt water tends to harden paint. There is not much difference as to the durability regarding the effects of salt and fresh water.

Removing Brunswick Black.—To remove Brunswick black from a stone mantelpiece previous to painting it, use American potash dissolved in water, and made into the consistency of paste by adding newly slaked lime. Apply this with an old brush, and let it remain on for a few hours, then wash off; if the first attempt does not remove the black, repeat the process. Care must be taken when using the potash, as it is dangerous to fingers and nails; should any of the liquid get on the hands, they should be at once well washed in water containing a little vinegar or a few drops of acid.

Preventing Rust in Kitchen Boiler.—A boiler can often be cured of rusting by giving it two or three coats of limewash to which has been added a little size to act as a fixative; about the same proportions should be used as in making a whitewash for a ceiling, but builders' ordinary quicklime must be used. The first coat must be well rubbed in. Before applying the limewash the boiler should be thoroughly cleaned, and as much rust as possible removed from the surface; then let it dry.

Meaning of Term Kilowatt.—This is a measure of electrical power or rate of doing work, and means 1,000 watts. It is usually applied to large electrical outputs, and can be determined by multiplying the electro-motive force in volts by the current in ampères and dividing by 1,000. Thus, if the electro-motive force at the terminals of a circuit were 200 volts, and the current in the circuit 250 ampères, the output would be $200 \times 250 = 50{,}000$ watts, or $\frac{50{,}000}{1{,}000} = 50$ kilowatts.

Sham Timber Building.—The usual way to get an appearance of old-fashioned timber work on a house is by nailing boards on the brickwork to represent the framed timber and plastering the intervening spaces flush with the wood; the plaster to be afterwards whitewashed, and the boards painted a dark brown. Tolerably stout deal boards should be used, and for plaster, Portland cement, with a fair proportion of sand, is advised. The arrangement of the sham timbers is a matter of taste; but suggestions are given in Figs. 1 and 2. By the "look-out in the roof" it is presumed that a dormer window is meant. The illustrations show such a window, which recedes a little from the eaves. It rests on, and is framed to, the rafters of the roof. Its triangular sides and gable will be of lath and plaster. In the elevation (Fig. 2) a roughly carved barge board is shown in the gable. This adds much to the effect, and should not be omitted.

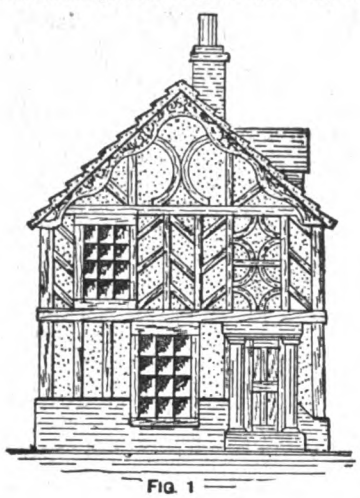


FIG. 1

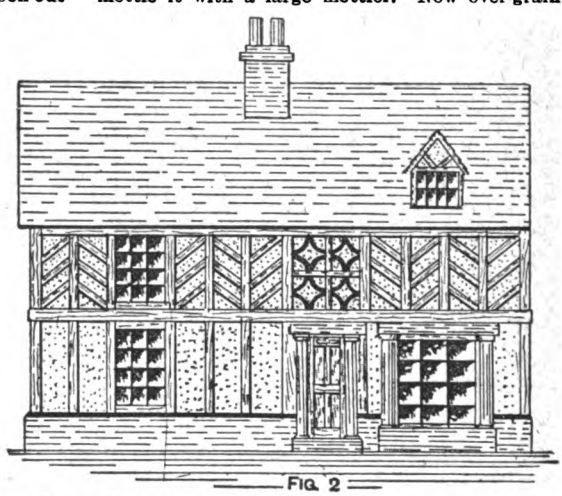


FIG. 2

Sham Timber Building.

Enamel for Coating Pills.—Finely powdered French chalk forms the white enamel used as a coating for pills. The pills are first dipped in a sugar syrup containing white of egg, then placed in the chalk in an agitating machine, the shaking thus polishing the outer surfaces of the pills and producing the enamel-like surface. The shaking could be done in a tin box if desired.

Far-reaching Signal Sounds.—An organ reed—that is, a reed with a vibrator larger than its aperture—produces a more powerful sound than any instrument of the flue-pipe variety. The wind pressure in each case being equal, a low note can be heard at a greater distance from its source than a high note, but a low note requires a larger tube. A note within the limits of a man's voice, say low F, would be suitable. This note could be produced with a tube about 3 ft. long. A great pressure of wind is not required. The most powerful organ pipes speak under a pressure of about the weight of 12 in. of water, that is, about 63 lb. to the square foot, but everything depends on the weight and flexibility of the vibrator. The conical tube used for a speaking trumpet is a suitable shape for a mouthpiece. Two instruments could be adopted, which may be used either together or alternately. A short sound followed by silence is better than a continuous note. If two notes are used together, they may be nearly alike as is the duplex whistle used by the police, or they may be tuned in the interval of a third major or minor. The combination of two sounds nearly alike gives rise to "beats," which are very effective as "noises." With two sounds representing the dot and dash of the Morse alphabet any signal can be transmitted.

Distinguishing Good and Bad Fur Skins.—When appreciating the good and bad points of skins of mink, marten, and other fur-bearing animals, every skin has its own special points, and age, season, and even sex must be taken into consideration. In a general way, the pelts of immature animals will be of little value—those from breeding females will in most cases be of no use—and every hole or tear will take off some value even from good skins. The best skins are obtained during the coldest parts of the severest winters when the underlying fur—the soft, downy part nearest the skin—will be thickest, and the internal part of the actual skin most free from black spots and patches.

Graining Walnut in Water-colour.—For the ground-work, give a coating of white lead 2 lb., Oxford ochre 2 oz., Venetian red 2 oz., burnt umber 1 oz., thinned with equal parts of turps and boiled oil. Damp the work thirty-six hours afterwards with water 7 parts, beer 1 part, then brush it over with weak beer, burnt sienna, and a little vandyke brown, and, when dry, mottle it with a large mottler. Now over-grain with a hog-hair over-grainer dipped into a thin mixture of vandyke brown and weak beer; use it very freely, and soften upwards only. While this is wet, the dark veins and curls should be put in with an over-grainer, using drop black thinned with weak beer. Soften in all directions. Glaze or shade with drop black and a little indigo. Do not overcrowd the work. When dry, it is ready for varnishing. Take as a pattern for the graining some article of furniture in walnut, such as the case of a piano.

Oak Finish for Yellow Pine.—Staining and French polishing will give the colour of oak, is generally considered the best finish, and is readily cleansed. Pine finish is easier to gain; generally the polish only will give it this appearance, especially if dark-coloured shellac is used. Mahogany and walnut tones are considered superior, the colour being gained by first staining. Oak is not advised as a first effort: to make the work look really well, and pass for oak, requires rather clever treatment. Shellac, 6 oz., dissolved in 1 pt. methylated spirit, makes French polish as used by most polishers. It gives best results when applied by means of polishing pads, but if applied with a camel-hair brush 2 oz. of resin should be added.

Varnishing Oil Paintings.—To finish oil paintings that have not been varnished, they should not, as a rule, be entirely coated with varnish, as this will tend to make them objectionably glossy. When a painting has become thoroughly dry, certain parts of it will be much duller than others, and these parts may be brightened by applying a little raw linseed oil with a hog's-hair brush. If the whole picture is dull and requires varnishing, a thin coat only of varnish may be put on. Both varnish and oil should be bought from an artists' colourman.

Polishing Flooring.—First coat the floor with a solution of patent knotting, made by adding ½ gal. of methylated spirit to each gallon of knotting. Place near the fire for half an hour; shake well before using. One hour after applying the first coat, glasspaper slightly; then give another coat. Now take some crude paraffin or paraffin wax and thin with turps; put this on with a brush. Now take a 14-lb. polishing iron, which has a long handle like a sweeping brush, the iron working on a swivel, heat it on a coke fire, then work it rapidly to and fro over the flooring. Do a small piece of flooring only at one time.

Perforated Metal Screen for Window.—To make a perforated tin or zinc screen for a window frame 35 in. wide by 30 in. high, cut from the metal sheet a rectangle 34⅛ in. by 29⅛ in. A tube frame round the edge makes a neat and strong finish. Now cut two lengths of ½-in. split brass tube 35 in. long, and two lengths for the ends 30 in. long; make the cuts at an angle of 45° so that the pieces of tube will mitre, and measure the lengths along the side of the tube opposite to the split seam. Place the tubes in position round the perforation, solder the corners strongly, and solder a semicircular-shaped piece of metal with a hole punched in it to the tube at the top corners, so that the screen may be hung on two brass hooks fixed at the sides of the window. Clean off the solder at the mitre joints, polish the tube, and enamel the perforated part green or other suitable colour, and the screen is finished.

Simple Folding Table.—Fig. 1 is an underneath plan of the folding table. A narrow frame A, about 2 in. deep, is fixed by means of screws or wood buttons to the underside of the top. The legs are connected to end pieces B, and fold inwards. The connecting pieces B

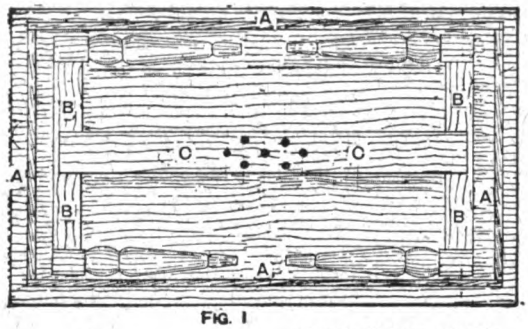


FIG. 1

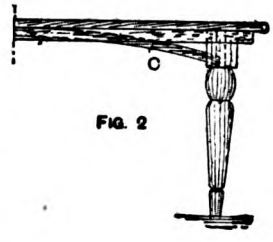


FIG. 2

Simple Folding Table.

are rebated on the inner edge, 6 in. by ½ in. The piece C is 6 in. wide and ½ in. thick, and is screwed to the centre of the table top as shown. This piece fits into the rebates cut in B, and serves as a spring to keep the legs rigid when the table is set up. Fig. 2 is a half elevation of the table showing the spring C fixed in the leg.

Painting Compo Work on Building.—To paint stone-colour newly composed work on the front of a house, mix well together 7 lb. of dry red lead, ½ gal. of boiled oil, 1 qt. of turps, but no driers. Coat the compo with this, and let it stand for forty-eight hours. Now take 7 lb. of white lead, ½ gal. of boiled oil, 1 qt. of turps, and ½ lb. of patent driers, and give the compo two coats of this, letting it dry well between each coat. Forty-eight hours after the last coat, take 7 lb. of white lead, ½ lb. of yellow ochre, and ½ lb. of patent driers; thin with boiled oil so that it will cover nicely. For washing down the remainder, boil in 1 gal. of water until dissolved ½ lb. of soap cut into thin shreds, then add one tablespoonful each of alum and carbonate of ammonia. Apply thoroughly with a brush, and wash off with cold water before the ammonia has had time to act on the paint.

Asphalt Damp-proof Course.—An ordinary damp-proof building course may be made by mixing 12 gal. coal-tar, ¼ cwt. pitch, and 2 gal. creosote oil. It will take nearly an hour to melt this quantity, and it should not boil more than a few minutes. After being poured upon the wall, which should be first swept and quite dry, it should be sprinkled with sand. The above quantities will cover about 12 sq. yd.

Composition for Making Cheap Combs.—The combs sold at a penny each are usually made of celluloid, a composition produced by treating collodion cotton with camphor and methylated spirit. The camphorated spirit dissolves the collodion cotton sufficiently to convert it into a gelatinous mass which can be pressed to any desired shape, and after evaporation of the alcohol this material becomes quite hard. To cheapen the material, large quantities of starch, zinc oxide, whiting, or barytes are mixed with the above material, yielding the ivory or bone-like products usually seen. The coloured varieties are made by incorporating pigments with the celluloid, and tortoiseshell and other forms are made by special treatment. To soften celluloid, break it small, add a small quantity of camphor, and then add sufficient spirit to cover the mass. After standing a few days it will be soft enough to work. Horn can be softened, but not dissolved, by treating it with caustic soda for a short time, while prolonged action of the alkali will convert it into glue.

Copying Manuscript by Photography.—The cheapest plan of copying manuscript books is to use one of the ordinary methods of copying written matter. This, however, necessitates the first copy being written out with special ink. If the writing is on one side of the paper only, procure some fairly pure paper and mix together (A) potassium ferricyanide 2½ oz., water 10 oz.; and (B) ferri-ammonium citrate 2½ oz., water 10 oz. Mix an equal quantity of each, and coat the paper by rubbing the solution well over it several times with a soft sponge or tuft of cotton wool. The paper should be coated as evenly as possible, but no notice need be taken of streakiness, so long as the paper has been well covered. A convenient tool consists of a glass tube through which slides a loop of fine wire holding a tuft of wool. When pulled up tight, the wire is wound around the top of the tube. As the potassium ferricyanide is exceedingly poisonous, it is not advisable to get more on the fingers than can be avoided. The paper is printed in contact with the drawing or writing in the usual pressure frame, or the sheets may be fastened together with wooden clips between two pieces of glass. Printing on this paper requires a longer time (six to ten times) than silver paper; but on taking the print from the frame it merely requires washing in water, to the first bath of which it is advisable to add a little citric acid. This process gives white letters on a blue ground. For black lines on a white ground the following is recommended. Make up three stock solutions: (A) Gum 1 part, water 5 parts. (B) Ferri-ammonium citrate 1 part, water two parts. (C) Ferric chloride 1 part, water 2 parts. For use, take (A) 30 parts, (B) 8 parts, (C) 5 parts. Develop with potassium ferrocyanide (or yellow prussiate) 50 gr., water 1 oz., and fix in a 10-per-cent. solution of hydrochloric acid. If the writing is upon both sides of the paper, the only plan will be copying through the camera. The book must be taken to pieces, and pages in consecutive order arranged on a board to go as near as possible into the size plate to be used, and copied on process plates, using hydroquinone developer. From these negatives enlargements could be made, or the optical lantern could be used. Great care must be taken to get a thoroughly sharp negative: use a lens with a flat field or a small stop and keep the negatives fairly thin. If, for example, the pages are 6 in. by 4 in., then twenty-four of these could be copied in one exposure on a half-plate, making seventy-five exposures in all. The wet collodion would be the best and cheapest process to employ.

Removing Iron Stains from White Marble.—Surface iron stains may be removed by applying a solution of oxalic acid and then washing with water; but if the stains have penetrated through the marble, they cannot be removed. They may be covered by applying a little lime cream (lime slaked with water) and, after drying, brushing over it a solution of silicate of soda, but this coating would be without polish. On highly polished marble, zinc-white ground with copal varnish and turpentine carefully applied might serve to cover the stains.

Removing Damp Stains from Pictures.—To remove damp stains from prints or engravings, they are immersed in a bath containing chloride of lime. Pastels, water-colours, and pencil sketches are more difficult to work upon; in fact, in the case of these latter it is almost impossible to remove damp effectually.

Double Seats for Shop.—Figs. 1 and 2 show the ends of two seats different in design for the centre of a shop. Fig. 1 is a double seat, with a footboard 10 in. wide raised 6 in. from the ground. Fig. 2 is a double seat 1 ft. 8 in. from seat to ground and 2 ft. 4 in. wide, with one centre back rail. The seat shown at Fig. 1 is 2 ft. 10 in. wide and 2 ft. 1 in. to the ground, and will be found very useful, as it enables the shopman to fit boots easily, A and B are back rails, and C the top rail. A centre leg will be necessary under the footboard and seat, and cross bearers framed into the longitudinal rails. The footboard may be made movable by framing the rails into the legs of the seat and fixing them by means of a bolt through each leg, tightened up on the inside with a wing nut.

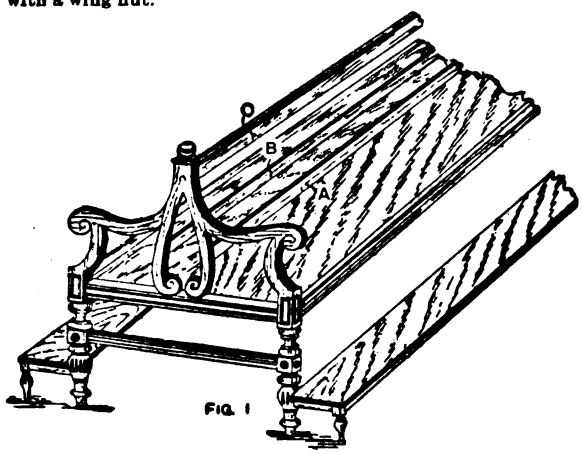


FIG. 1

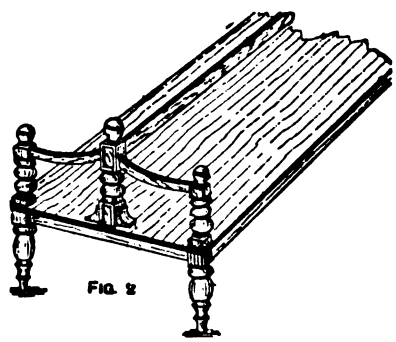


FIG. 2

Double Seats for Shop.

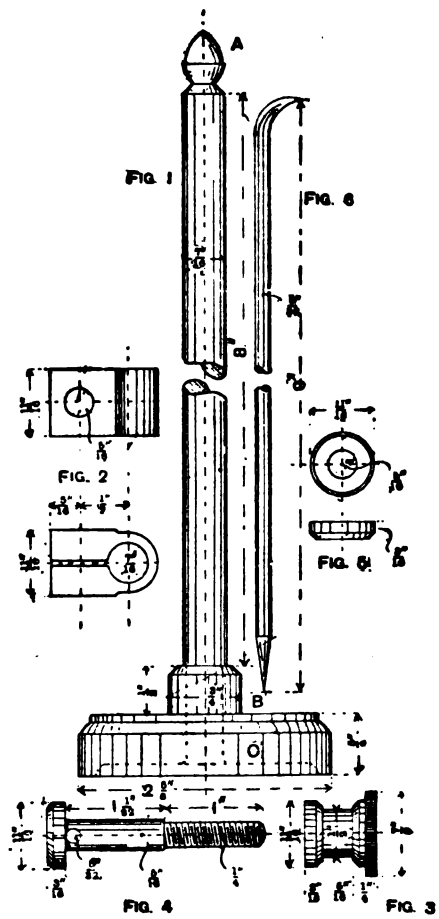
Strength of Beam.—The usual formula for finding the strength of a beam when simply supported at both ends is—

$$W = c\,\frac{b\,d^2}{L}$$

Where W = breaking weight in cwt. in centre, c = constant (3·6 spruce fir, 4·0 Northern pine, Dantzic, and Memel, 3·5 Riga, 4·3 Baltic oak, 5·0 English oak), b = breadth of beam in inches, d = depth of beam in inches, L = clear span or length of beam between supports in feet. Where the load is distributed a beam will carry double the amount. The safe load for temporary work may be one-sixth of the breaking weight, but for permanent work it is better not to exceed one-tenth.

Cleaning a Plaster Bust.—The best method of cleaning a plaster bust when it has got blinded by the finer markings getting dulled with dirt, is by careful scraping. If the whole figure is simply stained, or presents a dirty appearance, the best way is to give it a coat of knotting—a fine varnish that may be bought from any house painter—and, when this has become thoroughly hard, paint the whole with whitewash, adding a little glue to keep it from rubbing off too readily. Whitewash is preferable to paint for the reason that when the former becomes soiled it is easily removed by soaking the bust in water. The water will soften the whitewash, but leave the varnish underneath intact, thus making it possible to retain any delicate modelling there may be, and preventing the finer parts from getting filled up as they would be if a succession of coats of paint were applied. To attempt to wash the figure would only be to further rub in whatever dirt there was on it.

Making a Scribing Block.—The scribing block shown in the accompanying illustrations is made from a rod of mild steel 10 in. long and ¼ in. in diameter. This is turned down to ⅛ in., finished smooth, and quite parallel throughout its length. The top is finished off as at A (Fig. 1), and the other end, for rather more than 1 in., is turned and threaded ¼ in. A collar B is then screwed on tightly. The bottom disc of iron or



How to Make a Scribing Block.

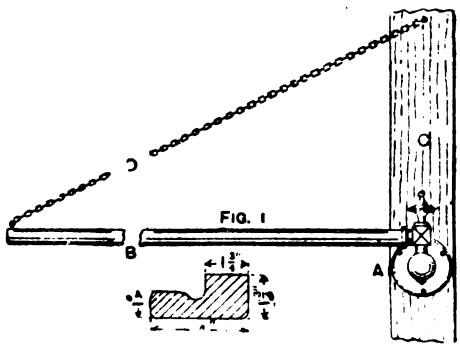
gunmetal C, with the bottom dished out, is tapped to suit the post. The hole in the sliding block (Fig. 2) should be a sliding fit on the post, the saw cut meeting the large hole; this will enable the block to grip the rod and scribing point when the nut (Fig. 3) is tightened. The steel pin (Fig. 4) should be turned, drilled, and threaded to fit the nut. Two washers (Fig. 5) are required, one being grooved diametrewise for the scriber to bed into; they are placed one at each side of the block (Fig. 2). The ends of the scriber (Fig. 6) should be hardened and tempered.

Clarifying Dextrine.—A solution of dextrine may be rendered clear by adding to each pint ½ drachm of alum dissolved in ½ oz. of water; shake thoroughly, and then add ½ drachm of washing soda dissolved in ½ oz. of water; again shake, and allow to stand for a few days. The hydrate of alumina precipitated out will carry with it the suspended matter and some of the colour, leaving the liquid much clearer and brighter.

Stiffening for Straw Hats.—For stiffening straw hats, thin glue size applied warm is generally used. Ordinary glue size may be employed for coloured straws, and parchment size for white straws. For black straws, add a little aniline black to the size to colour it. Spirit varnishes may be used for stiffening straw hats; ordinary French polish, diluted with methylated spirit, is also suitable.

Etching Brass Plates with Acid.—First make a pencil drawing on paper of the lettering to be etched; plain block letters will be the best for the purpose. Then get a brass plate of the size required and about ⅛ in. thick, and coat its polished side with white wax or ordinary bee wax. To do this, heat the plate and rub the wax evenly over the surface; then transfer the lettering to the waxed surface of the plate by means of carbon paper placed between the plate and the sketch, and marked with a pencil. The letters will then appear plainly on the plate. Then carefully scrape away the wax inside the outline of the letters, care being taken not to remove the wax from any part of the plate not to be engraved. A wall of wax is then put round the plate to retain the acid, which is then poured on the plate and left there until it has bitten deeply enough, when it is poured off and the plate washed in clean water. The plate should then be polished and the letters filled in with black japan varnish.

Simple Curtain Rod.—The accompanying sketches show at A an old gas bracket, large enough for a ½-in. rod as B fitted with curtain rings supporting the curtain. The bracket is screwed to the door-post C, and a brass



Simple Curtain Rod.

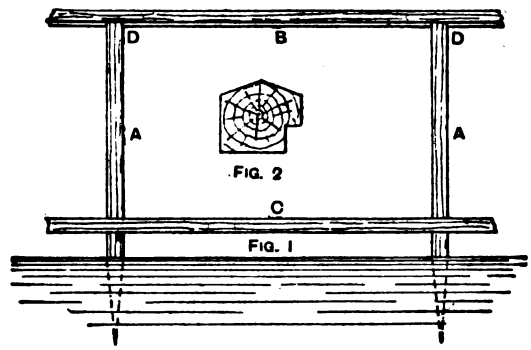
eyelet in the far end of the rod holds a brass chain D so that it will bear the weight of the rod, etc., the chain being attached to the post about 20 in. above the bracket A. Fig. 2 shows a piece of wood which is fastened to the wall to act as a stop to the rod.

Re-covering Cushion with Moquette or Wilton Pile.—For a seat 20 in. wide, allow 21 in. for the top, 1 in. for the joining seam at the back, 6 in. for the square front, and two piped seams, making a total width of 29 in., providing the seat cover is made out of one piece, as is usual with edge seams of cushions made of moquette or strips of leather. The heavy pile of the cloth prevents a neat appearance. The under lining can be made of black glazed linen. Machine up before commencing to stuff, leaving one corner open to put in the stuffing materials. If deep tufts are required, do not pack tight. If the front and back are made square the cushion will be reversible. Moquette is the French name for Wilton pile.

Aunt Sally Gallery.—An Aunt Sally gallery should be from 15 ft. to 20 ft. long and from 10 ft. to 12 ft. wide, and the apex of the roof from 8 ft. to 10 ft. high, sloping from 5 ft. to 6 ft. at the side. The posts or uprights, 18 in. of which should go into the ground, should be about 3 in. square; the apex piece for the roof should be 4 in. wide and 1 in. thick, and the framework for supporting the canvas should be 2 in. square. Fasten the woodwork together with small carriage bolts. The dolls, of which there may be one, two, or three rows, should be about 2 ft. high and about 2 in. apart, six or eight dolls being placed in each row. The foundation for a doll is a stick or piece of wood about 2 in. square and 2 ft. long. The head of the doll is made of tow or rags tightly wrapped round one end of the stick till it forms a ball 4 in. in diameter. The ball is covered with calico, the ends of which are tied round the neck of the doll; a coat of white oil paint is then applied, after which the face is painted in. The body of the doll is fashioned from rings of steel wire, the ends of which are bedded in the wood. First ring, the neck, 3 in. in diameter; second ring, the shoulders, 7 in.; third ring, 6 in.; fourth ring, 5 in.; fifth ring, the bust, 4 in.; sixth ring, the hips, 5 in. Rings 1 and 2, 1 in. apart; all the other rings 2 in. apart. The rings are connected to each other by lacings of finer wire, passing from top to bottom, the space between the lacings being 2 in. in the largest ring. The legs are made of calico stuffed with tow, and are attached to a piece of wire, 4 in. long, that has been driven through the centre of the wood just below the sixth ring. A frilled cap is placed on the head, and the dolls are otherwise dressed according to taste. Hinges are used for fixing the dolls to their perches.

Coke-breeze Concrete Floor.—In a large area of coke-breeze concrete flooring, the coke breeze should pass through a sieve of ¼-in. mesh, all larger pieces being broken smaller, and be retained on a sieve of ⅛-in. mesh, all the dust that passes through being rejected. The proportions should be 2½ parts of coke breeze, 2 parts of sharp clean sand, and 1 part of Portland cement. The whole of the materials should be carefully measured, and thoroughly mixed in a dry state. The water should afterwards be added slowly through a rose nozzle, and the materials turned over again at least twice to ensure thorough mixing.

Fixing Trellis Work.—The best way to fix a fence of trellis work is to drive stumps (A, Fig. 1) into the ground, and to nail on them a top rail B and a bottom rail C. The trellis can then be nailed to the face of the stumps and rails. The top rail should be 3 in. wide



Fixing Trellis Work.

by 2½ in. deep, the top being bevelled off to each side as shown in the section (Fig. 2), and a 1-in. by ¼-in. rebate made on the face side. The stumps should be 2½ in. square, and must be driven in the ground about 18 in., the top then being cut off to the right height. Each stump must be notched to receive the bottom rail, which must also be notched, so that when the two are together they will be level or flush on the face side. The top rail must be notched the depth of the rebate to fit on the top of the stumps, as shown at DD (Fig. 1), and, in fixing it, the rebate must overhang the face of the stumps; this prevents the wet from getting to the ends of the laths. The end stumps must be rebated in the same way as the top rail, to give a better finish.

Fitting a Mainspring to a Skeleton Clock.—Take the clock to pieces and obtain a spring of the correct height and length for the barrel. This should be about ⅛ in. less in height than the inside of the barrel, and when in, its wire should just be capable of slipping inside. Ease off the wire tie to the top edge, and slip the spring in, taking care that the hole for the hook is in such a position that it will slip on the barrel hook. When in as far as it will go, cut the wire tie and knock the spring quite down to the barrel bottom by taking the barrel in the hand and striking the bottom heavily on the floor or on a wooden bench. If unable to do this, hold the spring in a duster to protect the hands, and cut the wire tie. Then commence at the outside end and coil the spring in a portion of a turn at a time, holding it tightly to prevent it slipping out. Rest the barrel on a firm stool during the process and hold it with a duster for protection. The operation requires a firm wrist, as the spring must not be relaxed in the slightest degree until it is all in. A little bending with pliers when it is in will ensure the spring catching on the barrel arbor hook in the centre. When in and the cover is on, screw the square in a vice and, with the hands, wind it up by turning the barrel to the top to see that all is right. Plenty of oil should be applied.

Affixing Gold Leaf to Glass.—The only reliable medium for affixing gold leaf to glass is weak isinglass dissolved in rain-water. The backing should be red lead ground in varnish and thinned with turps. Cracking and chipping at the edges is due to the use of Brunswick black, japan, and asphaltum; these materials are unsuitable, because cold contracts and heat expands them to a very marked degree.

Cement for Repairing Marble.—A simple and excellent cement is made by beating the white of an egg in flour till the mixture is of the consistency of thin paste. This cement will even withstand hot water, and, on account of its colour, is not easily detected. Clear shellac or superfine plaster of Paris may also be used.

Method of Working Mouldings on Arches.—Arches of moderate span, say about 6 ft., can be worked as follows:—Two pieces of timbering should be bolted to the caps of the brickwork columns, on which another piece is fixed to take the bolt which is in the centre of the arch, and holds the radius rod in position (see elevation of arch, Fig. 1). A radius rod should be prepared, to the end of which the templates necessary to run the mouldings can be fixed. The plain part of the wall above arches should be flanked in with Portland cement, this then forming a screed on which the mould to work mouldings can travel. A mould should then be cut from a piece of wood to the shape of the moulding, ¼ in. less being allowed in every part to allow for the finishing coat. After this has been used to run the moulding in cement, another should then be prepared to the exact shape and size required, this one being faced, as shown in section of arch (Fig. 2), with either copper or zinc. The fine stuff is then laid on the cement backing, and worked to the required section by moving this mould round the arches by aid of the radius rod, as shown. After the moulding has been finished, the key block can be moulded and placed in position. The intersections of the arch mouldings can all be run by having the top part of the template, from the dotted line A upwards, hinged on to the radius rod, so that it can be held back while passing over intersecting points.

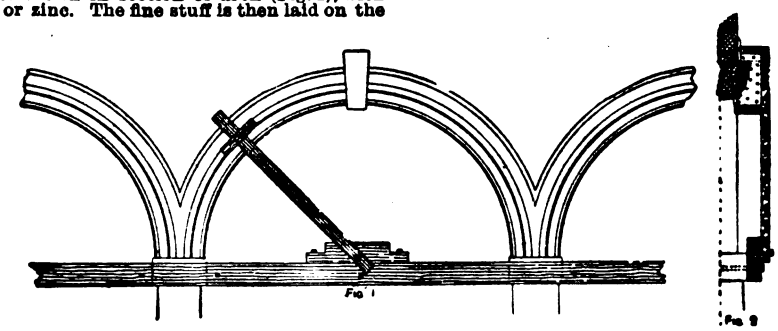


Fig. 1

Fig. 2

Method of Working Mouldings on Arches.

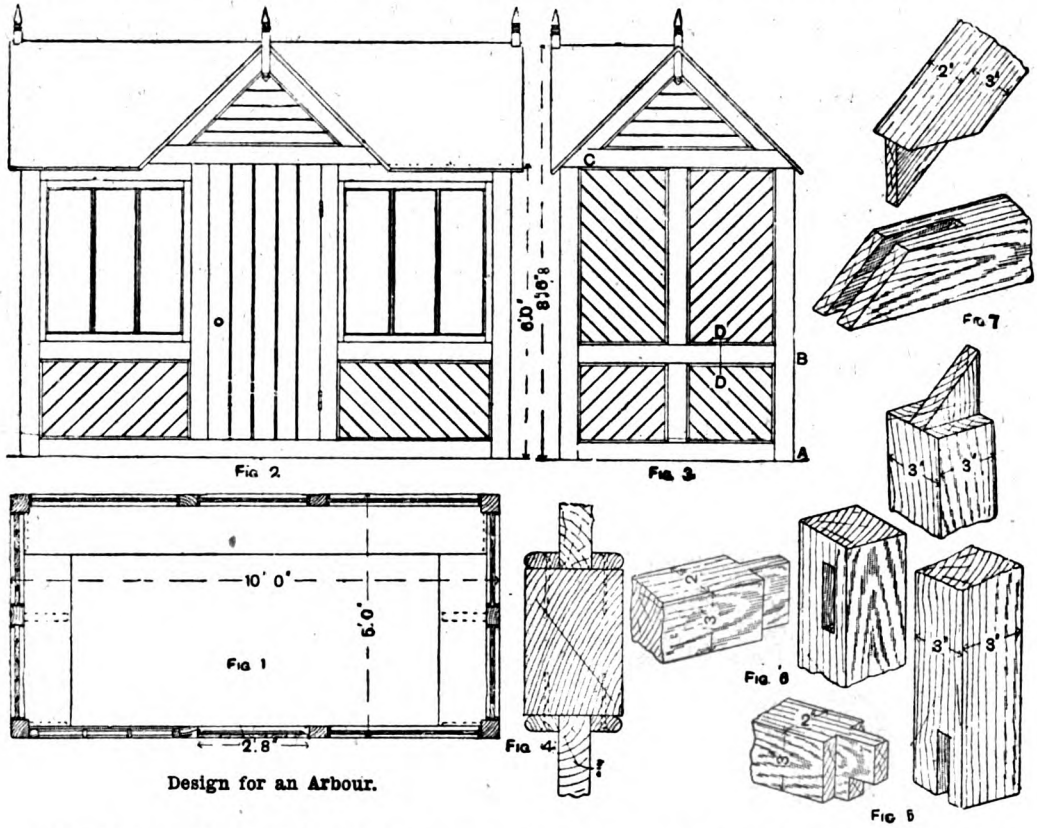
Improving Furnace for Melting Lead Ashes.—To improve a cube lead-melting furnace from which the slag comes out with the lead and blocks up the hole, the temperature of the furnace should be raised gradually and air allowed to enter the furnace to oxidise the sulphur contained in the coke. The front of the furnace should be luted with clay, and a tap hole made to remove the slag above the lead. If this cannot readily be done, add a shovelful of lime to stiffen the slag. The temperature can then be raised and more lime thrown in, if necessary, when the slag can be removed in lumps. A comparatively low temperature is required for rich slags and a high temperature for poor slags.

Making Saucepans.—When making round-bellied saucepans, first cut the pattern for a frustum of a right cone, using the length of the curve of the side as the slant for the cone, and the top and bottom diameters of the saucepan for the diameters of the ends of the cone. The body is hollowed, usually in tacks of four, on a tinman's block. Commence by working across from side to side on the block until the whole surface has been covered and the metal slightly hollowed equally all over. Now take the metal over a deeper hole in the block, and work along the bottom edge and up to the centre of the body, so that the curve of the lower part of the body stands out more boldly than the top. Again work over the whole of the surface until the metal is smooth. The tacks of bodies are then smoothed on a planishing wheel, separated, cleaned, and planished singly, either on the planishing wheel or on the anvil. A square notch is next cut at both ends of the top, and a corner notch at the bottom of the body. The ends are then prepared for a grooved seam by folding an edge over on one end upon the hatchet stake, and the opposite end is swaged with a hammer swage, which forms a bead of semi-circular section along the edge. Half of the bead is worked over inside with a round-faced hammer on a hatchet stake so as to form a fold, into which the fold on the opposite end will fit when the body is turned round. A flange is next thrown off along the top edge with a round-faced hammer on an anvil stake, and this flange is worked over towards the outside of the body upon a hatchet stake, the size of the flange being proportionate to the size of the wire which it is to cover. Draw the fold down over the wire with a mallet, using a round-headed stake for the body to rest on, and then close the fold down neatly over the wire with the wiring machine. With the mallet work round the two ends of the top to a radius equal to the top of the body, and then work the body round by pressure from the hands upon any convenient tool until it is circular at both ends; hook the folds together and draw them together closely upon the saucepan belly stake with a groover. Throw off an edge at the bottom with a jenny. Cut out the bottom, making it sufficiently large to allow an edge to be taken up to fit over that thrown off on the body. Planish the bottom by covering the surface with a number of blows from a flat planishing hammer upon a bright anvil. Next edge up the bottom and pene down the edge upon the edge on the body, work the edges partly over upon the hatchet stake, and close it down smooth and true upon a mandrel. Next rivet on the handle, solder round the bottom, along the groove, and over the rivet heads to complete the body. If a lip is required, the wired edge of the body is held firmly on an extinguisher stake at the place where the lip is to be formed, and a few smart blows are given with the heel of a mallet upon the wire at each side of the stake. A lip punch is then held firmly on the body from the wire downwards, and a blow delivered upon this gives the required taper. Oval bodies are the same size at the top and bottom, and are usually made in four pieces, the seams being formed in the same manner as for the round ones, and occurring at the parts of the oval where the side curve joins the curve of the end. When hollowing, the end pieces are hollowed deeper than the sides, and equally at the top and bottom. Oval bodies are usually wired after being grooved together.

Warming Buildings by Hot Water.—The customary method of calculating the amount of hot-water radiating surface required to warm a building is to allow so many superficial feet of radiating surface per thousand cubic feet of space in each room, hall, or corridor. Thus, in living-rooms (a dining-room, for instance), it is usual to allow 15 ft. of radiating surface per thousand cubic feet of space, and such a room measuring 15 ft. by 20 ft. by 12 ft. high—which would have 3,600 cub. ft. capacity—would need a radiator with 54 ft. of surface to it. Entrance halls need 20 ft. per 1,000, as practically all cold air enters here and should receive warmth before going farther. Bath-rooms, 20 ft. per 1,000; bedrooms, 10 ft. to 12 ft. per 1,000. These figures will give an idea of what will be needed for other purposes. They will afford a temperature of about 62° when there is a hard frost outside. The piping used is the "red steam" quality. This is stronger than gas or water pipe. Custom has decided that this is the quality of pipe to use, but except in very high buildings such a thick pipe is not needed as regards its ability to resist pressure. Boilers are made of $\frac{1}{16}$-in. and $\frac{1}{8}$-in. iron, and capable of withstanding any ordinary pressure, but with high buildings the saddle boiler or any shape having large flat surfaces should be avoided, as the plates may bulge out.

Removing Zinc from Solder.—To remove the zinc, just melt the solder in a pot, then take it off the fire and stir in a good handful of powdered sulphur or brimstone until the whole is of the consistency of wet sand. Replace the pot on the fire and melt, *but do not stir* the contents. The sulphur and zinc will rise to the surface and form into a cake. Now take the pot off the fire and carefully remove the cake without breaking if possible. This can be done with two pieces of hoop iron with bent ends.

Design for an Arbour.—Fig. 1 is a plan with dimensions marked, Fig. 2 a front elevation, and Fig. 3 a side elevation; at Fig. 4 is shown a section through a rail and boarding, as at D D (Fig. 3). Fig. 5 shows the construction of the joint at A (Fig. 3), Fig. 6 that at B, and Fig. 7 the group at C. The general dimensions and sizes of the principal members are also shown. For the panels and roofing, ¾-in. prepared matchboarding will be most suitable; the roofing should be covered with felt. The



Design for an Arbour.

sash could either be made fixed or hinged. The arrangement of the seats is shown in Fig. 1. A simple method of fixing the boarding to the framing by means of beads at each side is shown at Fig. 4.

Making Moulds for Sugar Toys.—First make a model of the toy in wax, and take a cast of this in plaster of Paris. To do this, procure a small wooden box which will hold the wax model comfortably. Mix some plaster of Paris with water to a very thick cream, and pour enough of this into the box to about one-third fill it. Next place the wax model upon the plaster with its base pressed against one side of the box, and fill up with more plaster. When the plaster has set, take the box to pieces, remove the wax model, and with a fine saw very carefully cut the mould in half. The cut faces may be smoothed by scraping carefully with a knife so that they fit close together. The mould may be improved by warming and rubbing it with warm paraffin wax or a waxed cloth until it has received a slight polish. In using the mould, bind the two halves together with rubber bands and force the sugar paste or syrup through the opening left by the base of the wax model until the mould is quite full. The colours now used are harmless coal-tar (aniline) dyes sold specially for the purpose. If a glaze is employed, it is either sugar syrup alone or sugar syrup to which white of egg has been added. The toys made from pure sugar will not melt in the sun.

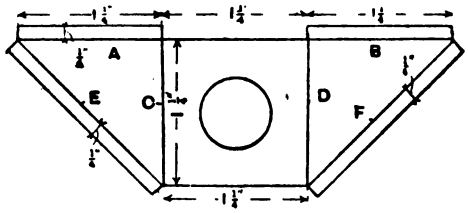
White-enamelling Furniture.—For white-enamelling the surface of new wood, the foundation is built up with gilders' washed whiting and patent or parchment size; three coats at most should prove sufficient. This is smoothed down with worn glasspaper. At least four coats of white enamel should then be applied, allowing each coat time to dry before applying the next. A superior finish can be obtained by French polishing the surface, using transparent polish with or without the addition of flake white, as the undercoating may require. If the furniture has previously been enamelled, it is not necessary to remove the old enamel right down to the wood. The surface should be freed from grease by thoroughly washing with warm water in which a small teacupful of washing soda has been dissolved. A little pumice powder will prove beneficial if the furniture is very dirty. The whiting and size may be omitted, and the surface built up with two coats of white enamel, as in new work. A suitable enamel can be made by mixing finely crushed flake white in transparent polish; strain through muslin before use. For a bright finish, mix flake white in best quality white hard varnish.

Fitting a New Mainspring Barrel to a Watch.—In an English lever with fusee and chain, the fitting of the barrel is a very simple job, the barrel being merely a brass box. Take the rough barrel and broach out the bottom hole to fit the bottom shoulder of the barrel arbor tightly. Serve the cover in the same way. Then turn the inside of the cover central boss down until the top shoulder of the barrel arbor just appears through. Turn down the inside bottom boss until the arbor has just a little end-shake in the barrel; then put in the hook and cut the chain hook-hole. For the latter, drill two small holes in the barrel and broach one slanting into the other. To turn the barrel and cover with turns, place them on arbors; with a watch lathe, hold them in step chucks and use the slide-rest. For a Geneva barrel with stop-work, if possible use the old cover with the stopwork on. When finished, ease the arbor in the holes at top and bottom.

Finishing Cement Cornices.—A smooth finish is obtained by the use of fine Portland cement mixed neat. As this works "short," it is left a little time till it begins to set; then fresh water is added, and it is beaten up again. This process brings the cement to the state known as "killed," when it sets more slowly, attains a less ultimate strength, and works easier in the running of the mouldings. If this last coat is laid some time after the body of the work has set, it is advisable to wet the surface on which it has to be placed so that the moisture is not drawn out of the finishing coat too quickly.

Material for Sketching on Glass.—To make the material used by sign-writers for outlining letters, etc., on glass, melt together 4 parts of stearic acid, 3 parts of mutton suet, and 2 parts of beeswax. Add 6 parts of red lead and 1 part of purified carbonate of potassa. Mix well together and pour in glass tubes or hollow reeds to set.

Making a Finder for a Hand Camera.—To make a finder for a hand camera, procure a plano-convex or bi-convex spectacle lens, unedged or centred, of about 1-in. focus (cost, 3d.); also a piece of zinc and a piece of silvered glass. Cut the zinc to the shape shown in the figure, and bend on the lines A, B, C, D, E, and F. The first two, being bent outwards, enable it to be attached to the camera top; and the last two, bent inwards, form a support for the ground glass, which rests at an angle of 45°. Without knowing the make of camera it is intended for, it is impossible to state how the finder should be finished and attached; a very common plan, however, is not to make the finder complete in itself, but to let the camera top and front form the remaining sides. In this case, cut an opening in the camera top 1¼ in. by 1 in., and sink a rebate to hold the ground glass, rough side inwards. This may be



Making a Finder for a Hand Camera.

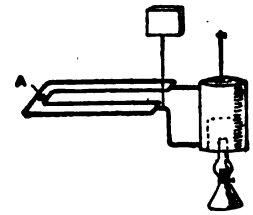
fixed in with pins. Fix the frame with the mirror, and sink the lens in a recess until the image is sharp, then fasten in with a ring of wire. With strips of black paper, block out on the ground glass of the finder as much of the picture as is not shown on the screen of the camera. The best finders for instantaneous work are those of the brilliant pattern, but these are not easily made. One should be chosen the image of which does not vary with the angle at which it is viewed.

Power of Model Steam Engine.—A steam engine has a steam pressure of 25 lb. per square inch, the bore of the cylinder being 1 in., the length of the stroke 1¾ in., and the speed 350 revolutions per minute. The maximum effective pressure may be 22 lb. per square inch. The area of the piston is $1 \times 1 \times .7854 = .7854$ sq. in., and the length of the stroke is $\frac{1\frac{3}{4}}{12} = \frac{7}{48}$ ft. Then, if the engine is double-acting, and the steam supply is kept up throughout the stroke, the maximum indicated power will be $\frac{22 \times \frac{7}{48} \times .7854 \times 350 \times 2}{33{,}000} = \frac{1}{10}$ horse-power (say). The maximum brake-power will be less than this—say $\frac{1}{12}$ horse-power.

Light Oak Graining.—To grain and varnish yellow deal a light oak, first kill all knots by applying a coat of shellac (knotting) over them; then prime with light colour. When the priming is dry, putty holes and make joints good, etc. Now paint a second time with light colour; when this is dry, lay on a ground made of 1 lb. of white lead, 2 oz. of patent driers, and 2 oz. of Oxford ochre. Thin with oil or turps (some grainers prefer a dead ground, others a bright ground to grain upon). Forty-eight hours after the ground is dry, rub down slightly with fine sandpaper. The work is now ready for graining. The graining colour should consist of 2 oz. of vandyke brown or 2 oz. of burnt umber. To this should be added, for a warm shade, 1 oz. of burnt sienna; for a cold shade, 1 oz. of raw sienna. Thin with equal parts of oil and turps, and add driers in the proportion of about 1 oz. to 1 pt. Brush over the work sparingly with the above colour, getting it as even as possible. Now draw a coarse graining comb down the board or panel the way the grain is to run; then with a fine comb go over the coarse combing in a zig-zag manner; this will cut up the combing like the fine fibres seen in real wood. Now take a piece of rag, fold it over the thumbnail, and wipe out the lights. The most important thing in graining is to get clean joints. Even if the work is otherwise well done, a bad joint spoils it. The work is then ready for coating with copal varnish.

Affixing Anaglypta.—When attaching Anaglypta and Lincrusta Walton to ceilings and walls, all but light quality should be trimmed with a metal-edged straight-edge and a sharp knife, such as a shoemaker's knife. The material having been cut to the required lengths and trimmed, should be pasted with ordinary paper-hangers' paste. Let it stand for fifteen to twenty minutes, then cover it with ordinary paste to which is added one-fourth glue, and at once hang the material before it commences to dry. Use a cloth for pressing the Anaglypta to the wall, as a roller presses down the relief. Lincrusta is hung in a similar manner, but for this a roller can be used, as the relief is solid. A better finish is gained by first lining the ground with a common brown paper.

Heating Chicken Rearer.—The accompanying sketch shows a small heater 8 in. by 6 in., with about 9 ft. of ¾-in. pipe attached. There is an air valve on top of the heater, and a small filling cistern is connected to the return pipe. This would fail owing to air in the pipes, and it must be difficult to fill the pipes without locking air in with the pipes arranged as shown. Putting an air pipe to each pipe at the point marked with an asterisk at A should prove a remedy, these two air pipes either going up separately or joining together, but in each case they must go as high as the little cistern. This point should be the highest point in the circulation, the flow pipes from the top of the boiler rising, say, 1 in.



Heating Chicken Rearer.

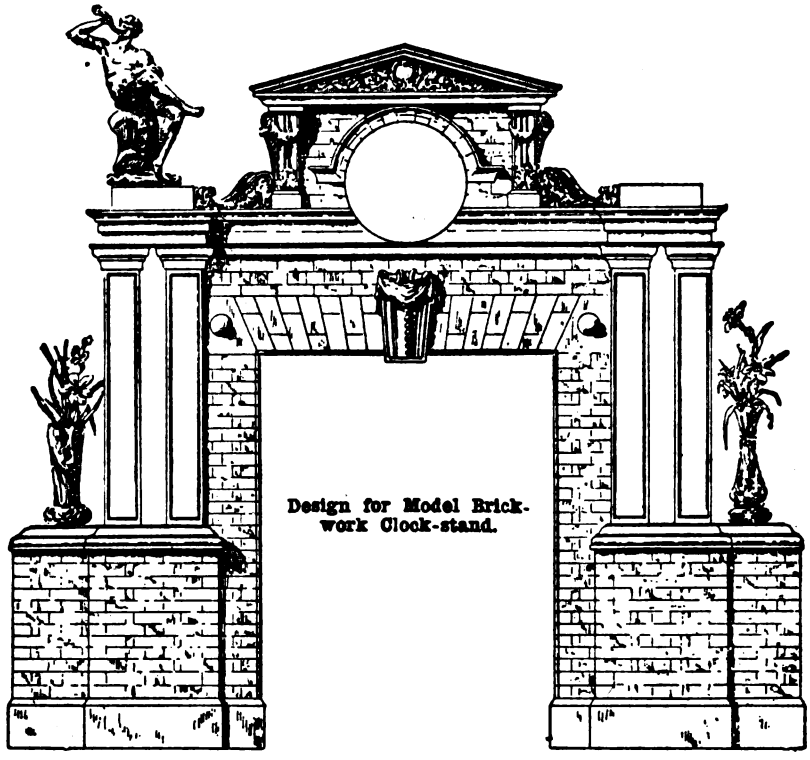
to the air pipes, and then descending 1 in. from this point towards the cistern connection.

Making Tube Chimes.—A set of chimes may be made from tubing suspended from a frame. These metal tubes are open at each end, and composed of a special alloy. Their musical pitch varies according to their thickness, diameter, and length. The longest tubes sound the deepest notes, and are usually both larger and thicker. If the tubes were all of the same material and diameter, their pitch would vary solely according to their length; and given two tubes, one twice as long as the other, the long one would sound the same note as the short one, but one octave lower. Eight is a good number for a peal, tuned to a complete octave. The distance apart does not affect the tone. The tubes are suspended by silk or leather thongs threaded through holes at each side near the top. They are struck near the top end with leather-faced hammers. To form the scale, make one (the longest, 2 ft., 3 ft., or 4 ft., according to fancy and the note desired) and set its measurement down on paper, for the longest, and another, half its length, for the shortest; then draw a slanting line from the lower end of one to the lower end of the other. If the remaining six tubes are now drawn in between the longest and shortest, at equal distances, the slanting line will cut off each to its proper length. These lengths are only approximate, and the tubes will require tuning in unison with an octave on a piano, cutting them down carefully until each one sounds the note desired.

Cement Rendering on Rubble Wall.—Portland cement and sharp sand should be used in the proportion of, say, 1 cement to 3 sand. The cost would vary with local circumstances, but might be about 2s. per yard super. for plain face finished from the hand float, with, say, 3d. per yard extra for jointing to imitate ashlar work; mouldings, say ½d. extra per inch girth per foot run; arris edges, 1d. per foot run. A rubble wall is generally supposed to be required one-third thicker than a similar brick wall. Brickwork, say 9 in. for top floor, and 4½ in. extra for each floor below. Rubble walling, say 12 in. for top floor, and 6 in. extra for each floor below.

Working Paper Pulp.—To give the pulp tenacity, it is boiled in a solution of gum arabic or size. To make figures, the pulp is poured into the mould and a counter mould pressed over the mass so as to make the casting a mere shell. For flat articles, like trays, etc., different thicknesses of sheets of paper are glued together and pressed so as to become one. To make casts of heads in relief, stiff, unsized paper is damped and placed with the dry side next to the figure to be moulded. It is then patted with a cloth into all the markings of the object, and after about five minutes is taken off and left to dry. A polish impervious to water is obtained by using a varnish composed of turpentine, amber, and ivory black. This is applied in a heated room, and the cast afterwards placed in an oven.

Design for a Model Brickwork Clock-stand.—The accompanying design represents a gateway, over which is the opening for the clock. Two types of arches are shown—one camber or flat, the other semi-circular. There is very little enrichment, and what there is might be dispensed with and plain brickwork substituted. The string-coursing, capitals, and bases of



Design for Model Brickwork Clock-stand.

the pillars could be made of 3-in. moulded bricks. The chamfered plinth might also be constructed of bricks, though plain terra-cotta pieces of the full depth would be preferable. The brickwork could be carried out as far as the outside pillars, and still leave sufficient space for the small flower vases as shown in the design. If the space between the pillars be left empty, a second pillar will be required at the back to support the entablature. Small statuettes, vases, or any bric-à-brac, might be appropriately placed over the pillars as illustrated, or a mirror could be let into the vacant space for the gateway. An approximate idea of the sizes may be gathered from the courses of brickwork.

Darkening Mahogany.—To darken mahogany, enclose the finished articles in an air-tight box, on the floor of which are placed a number of shallow dishes containing liquid ammonia ·880 per cent. The fumes, which may play around for hours, have such a penetrating power that a thin shaving of the wood might be taken off without disturbing the colour; this treatment does not raise the grain. Stains may also be applied with a brush. Dissolve 1 oz. of bichromate of potash in 1 pt. of water; two or three applications of this may be given, and, when the stain is dry, the colour may be enriched by wiping over with red oil, obtained by steeping 2 oz. of alkanet root in ½ pt. raw linseed oil. Common washing soda, carbonate of soda, or water in which lime has been slaked, will give different shades. A French method is to rub the surface with dilute nitric acid, which, when dry, may be brushed over with a solution of 1½ oz. dragon's blood and ½ oz. carbonate of soda dissolved in 1 pt. of methylated spirit.

Brickwork and Foundations for Tall Chimney.—In constructing chimney shafts for Lancashire boilers, the area of the chimney at the top is based upon the size or capacity of the boilers. Thus, area in square inches $= \frac{180a}{\sqrt{h}} = \frac{100\,HP}{\sqrt{h}} = \frac{15\,F}{\sqrt{h}}$, where a = area of fire-grate in square feet, HP = indicated horse-power of engine, or F = quantity of coal consumed per hour in pounds. The diameter externally at the base should be $\frac{1}{12}$ to $\frac{1}{15}$ of the height. The latter should be 0·3 in. to the foot, or about 1 in 33, though this is not imperative. The brickwork should be 9 in. in thickness for the top 25 ft., and increase half a brick at each 25 ft. from the top. If the inside diameter at the top exceeds 4 ft. 6 in., the top length should be 1½ bricks thick, and each of the lower lengths consequently half a brick thicker. The foundations should be carried down to the solid; they should be spread out so as to make a good broad base, and the load on the foundation should not exceed 1 ton on the square foot. After arriving at what appears to be a solid bed, it is a good plan to sink a trial hole under the centre of the chimney some feet lower; if the ground is found to be good, the hole may be filled with concrete at 10 or 12 to 1. The base for the chimney should consist of a solid block of concrete, 6 to 1, not less than 2½ ft. or 3 ft. thick; and as concrete is cheaper than brickwork, it may be carried up in concrete to the invert of the flue.

Making Crocus Powder.—Crocus is an oxide of iron, and it is made by calcining copperas (sulphate of iron); the residue is divided into two portions, a bright red powder known as rouge, and a bluish-red powder known as crocus.

Making Putty Powder.—Putty powder is made by heating metallic tin in a furnace, and thoroughly stirring it so as to bring it in contact with the air; the tin is gradually oxidised, forming first a grey powder and finally a white powder of oxide of tin, or putty powder. The commoner kinds of putty powder are made from an alloy of 75 parts of tin and 25 parts of lead.

Graining Mahogany in Water Colour.—Mahogany graining should be worked on a ground made from white lead, venetian red, and chrome. First damp the work to be grained with a sponge dipped in water to which has been added a little fuller's-earth or whiting; this will prevent sissing. The colours required are vandyke brown, burnt sienna, mahogany lake, and blue black—all ground in water; these may be bought in tubes from 1s. each. The tools required are a 3-in. mottler, a medium-size sash tool, a thin hoghair overgrainer, a small bevelled cutter, a sable pencil, and a badger hair-softener; these would cost from 10s. upwards. The method of working is as follows: Rub up on a palette a little vandyke, burnt sienna, and lake with weak beer and water, keeping each colour separate; dip the sash tool in the colours and cover the work, which in some places should be dark and in others light, in the direction of the grain. Next dip the mottler in water, wipe it on the washleather to take out superfluous water, then mottle the work to imitate the real wood; soften off with the badger brush. Higher lights or feather markings can be taken out with the cutter; soften the work as it proceeds. The work may next be overgrained by using the thin overgrainer with blue black. Divide the hairs by drawing it through an ordinary comb whilst wet. Use the sable pencil for the fine or feather work.

Weight, Measurement, and Strength of Timber.—Information on the weight, measurement, and strength of timber is scattered through various books, from which the following table is extracted:—

Timber, Selected Quality.	*Weight lb. per cub. ft.*	*Ultimate Tensile Strength tons per sq. in.*	*Ultimate Compression tons per sq. in.*	*Coefficient of Transverse Strength.*	*Ultimate Bearing Pressure tons per sq. in. across Grain.*
White pine	28	—	1·8	3·8	·27
Spruce fir	31	1·5	2·5	3·6	·22
Larch	35	1·5	2·5	3·5	—
Honduras mahogany	35	1·5	2·8	4·9	·58
Elm	37	2·0	3·0	3·0	—
American red pine ...	37	—	2·2	4·0	—
Northern pine	37	1·5	2·9	4·0	·60
Kauri pine	38	—	2·8	4·8	—
Ash	45	2·0	3·5	5·0	—
Beech	47	1·9	3·8	4·5	—
Baltic oak	48	3·0	3·2	4·3	—
Pitch pine	50	—	2·9	5·0	·76
English oak	50	3·0	3·2	5·0	·90
Teak	50	3·0	3·8	5·0	—
Spanish mahogany ...	53	1·8	3·0	5·0	1·9
Greenheart	60	—	5·8	8·0	—
(1)	(2)	(3)	(4)	(5)	(6)

The safe load in tension and compression, columns 3 and 4, would be from one-tenth to one-fifteenth of the amounts given. The safe bearing pressure across the grain of timber as at the ends of a beam will be about one-fifth of the amounts given in column 6. Column 5 gives the coefficient C in the formula $W = C\,b\,d^2 + L$, and the safe load would be about one-sixth of W for temporary work, or one-tenth for permanent loads.

Deepening the Colour of Electro-gilding.—When chains, etc., are electro-gilt their surfaces are coated with a film of pure gold, which assumes a pale yellow tint when deposited from a new solution, or from a slightly warm one, or by a very low tension current. The colour may be deepened by re-dipping in an old solution or in one heated to 180° F., or under the influence of a 10-volt current. If the chain is made of bronze, copper, or dark brass, or coated with a deep colour gold, the deep colour may be restored by carefully heating it on a sheet of iron over a gas stove, or over a charcoal fire. The chain must be moved about whilst being heated, and removed at once when the colour comes. When cool, it must be polished by brushing with a hard brush.

Varnishing Oil Paintings.—The primary object of varnishing an oil painting is to protect it, much in the same way as glass is put over a water-colour drawing; in fact, valuable or delicately painted oil pictures are often protected by glass, and a lot of future trouble saved. Mastic varnish is used for oil paintings because a thin coat is generally sufficient to bring out all the detail in the dark parts without giving a vulgar gloss. It has very little colour, and can be easily removed when necessary, which is not the case when a "durable" varnish, that is, one made from hard gums and drying oil, is used. An oil painting from the artist's studio should be carefully hung up to lean forward slightly, so as not to catch any dust, etc., certainly *not* over a fireplace or near a gas burner. At the end perhaps of about three years the surface dirt, fly spots, etc., should be removed with a clean wet cloth (not flannel) and a coat of varnish applied. This will protect the surface of the picture from future atmospheric influences; in fact, all dirt, etc., will be on the *varnish* instead of on the *picture*. Mastic varnish will sometimes "bloom," that is, the picture will be covered with a slight opalescent film. This can be removed by breathing on a small portion at a time and gently rubbing in small circular strokes with a tuft of cotton wadding. Never *partially* varnish a picture, because even mastic will turn yellow with age, and show an objectionable distinction between what is varnished and what is not.

Comparison of Beaumé Hydrometer Degrees with Specific Gravities.—The degrees in the Beaumé hydrometer for both heavy and light liquids can be transposed to ordinary specific gravities by the following tables, from the German. The first is for liquids heavier than water:—

B. Degrees.	*Specific Gravity.*	*B. Degree.*	*Specific Gravity.*	*B. Degrees.*	*Specific Gravity.*
0	1·000	18	1·134	46	1·434
1	1·007	20	1·152	48	1·462
2	1·013	22	1·167	50	1·490
3	1·020	24	1·188	52	1·520
4	1·027	26	1·206	54	1·551
5	1·034	28	1·225	56	1·583
6	1·041	30	1·245	58	1·617
7	1·048	32	1·267	60	1·653
8	1·056	34	1·288	62	1·689
9	1·063	36	1·310	64	1·727
10	1·070	38	1·333	66	1·767
12	1·085	40	1·357	68	1·809
14	1·101	42	1·381	70	1·854
16	1·118	44	1·407	75	1·974

The following table applies to liquids lighter than water:—

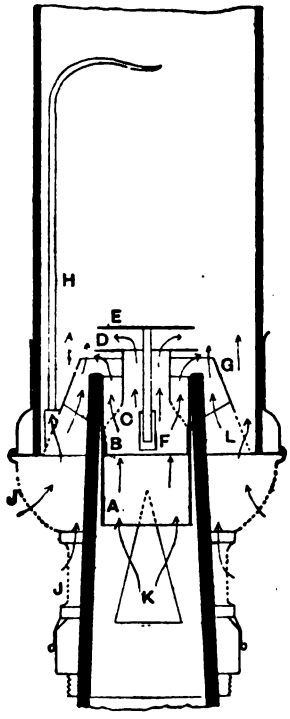
B. Degrees.	*Specific Gravity.*	*B. Degrees.*	*Specific Gravity.*	*B. Degrees.*	*Specific Gravity.*
10	1·000	20	·936	44	·811
11	·993	24	·913	45	·807
12	·986	25	·907	48	·794
13	·980	28	·890	50	·785
14	·973	30	·880	52	·777
15	·967	32	·869	55	·764
16	·960	35	·854	56	·760
17	·954	36	·849	58	·753
18	·948	40	·830	60	·745
19	·942	42	·820		

Phosphorescent Paint.—Luminous paints require direct sunlight for some time, and the phosphorescence they display in the dark only lasts for a few hours. Luminous paints are usually made by heating oyster shells in the fire until they become white, and then placing them in a crucible with sulphur and melting. Another method is to mix thoroughly 100 parts chalk and 40 parts flowers of sulphur, and heat in a closed crucible until fumes cease to be evolved. Powder the residue of calcium sulphide, mix with the smallest possible quantity of gum water or glue size, and use it as a paint; it is said to be not so good if mixed with boiled oil or varnish. Luminous paints can also be made by using strontium carbonate in place of chalk.

Oxidising Steel and Silver.—To oxidise silver chains to a good dark colour, dip them in a solution of potassium sulphide 24 grains, sal-ammoniac 40 grains, water 1 pt. For steel chains, dip them in sodium hyposulphate 200 grains dissolved in water 1 pt., then rub with sand or a scratch-brush. Repeat till the desired colour is obtained.

Meaning of Term "Ampère-turn."—The term "ampère-turn" is applied to winding dynamos and electrical instruments. The magnetising effort of a coil carrying a steady electric current depends on the product of the number of the complete turns or loops in the coil and the current in ampères, and the magnetic effect thus produced is measured in ampère-turns. Of course, the coil is supposed to be wound so that the magnetic effect of the turns is in one direction. Thus, if a coil of sixty complete turns carries a current of 5 ampères, the magnetic effect of the coil is 60 × 5 = 300 ampère-turns.

Incandescent Burner for Oil.—The accompanying sketch shows an ordinary central draught oil lamp argand burner adapted for use with a mantle. It is so designed that the entire outside, including mantle and chimney, lifts off for lighting and trimming, and leaves the wick-tube standing clear. This is not absolutely essential, but it lessens the risk of damaging the mantle. The tube A fits into the wick-tube as shown, and can be removed if a mantle is not available, and carries with it all the special fittings. Another tube B is attached to A, contracted, and perforated at C. On the top a flange D is fixed. Inside B a socket F is fixed to support the disc or "spreader" E. A cone G is attached to the removable part of the burner, from which the wire H rises to support the mantle. When the wick is lighted, and raised about halfway between the top of the wick-tube and flange D, air enters through the triangular space K (always present in a burner with a conical wick-tube). Part of the air-current goes through the perforations C in B and is slowed down by so doing. It is directed against the inside surface and edge of the wick, and develops from the wick the gas of combustion. A rapid current of air enters through perforations J, and

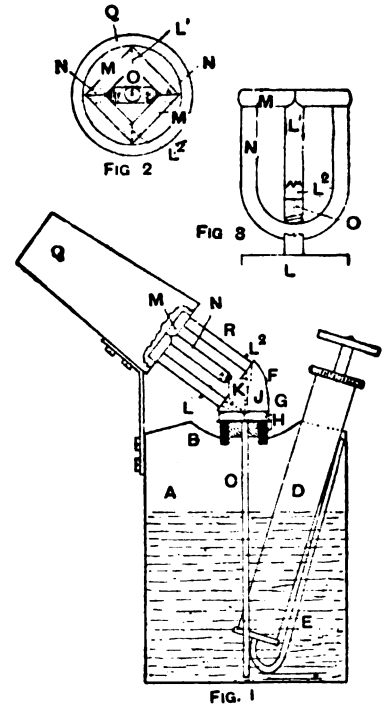


Incandescent Burner for Oil.

rises between cone G and the wick-tube, and carries the flame up from the outside and outer edge of the wick, whereby a blue flame of intense heat is produced. Another current of air rises in the centre of the burner and issues laterally between flange D and spreader E. This causes a whirling or eddying motion of the air and the vapour of the oil, ensuring thorough mixture and freedom from soot and smell. It also causes the flame to rise in the form of a long cone, completely enveloping the mantle. Yet another air-current rises through the perforations L and keeps the flame away from the chimney. The air-currents are indicated by arrows without letters appended. A cone outside G, and somewhat higher, may be added, over which the end of the mantle will slip, and thus will be held steady whilst the lamp is moved about. The wick winder is not shown. Some experiment will be necessary to get the right proportions between the air-currents.

Fastening Range Tap.—To fasten a brass tap that has become loose in a kitchener, the nut on the tail of the tap inside the boiler must be loosened and removed and fresh packing material put around the tail before replacing the nut. The usual packing is a ring of hemp, called a "grummet," which has a mixture of red and white lead worked into it, and this, when compressed by the tightened nut, makes a sound joint which soon hardens. Leather should not be used, but a collar cut out of sheet indiarubber will make an excellent and clean joint quickly prepared. The hole in the rubber over the tail of the cock (inside the boiler) should be a close fit.

Making a Paraffin Blow-lamp.—The paraffin blow-lamp here shown is used for removing paint from doors, etc. The reservoir A is made of thick sheet brass strongly soldered. It has a hollow B in the top, in the centre of which the burner is screwed, an asbestos washer making all air-tight. A pipe C, about ¼ in. bore, is soldered into the burner, and reaches nearly to the bottom of the reservoir. An air-pump D is soldered or screwed into the reservoir, so as to permit the burner to be screwed in, and a piece of small tube E conveys the air from the pump to the top of the reservoir. The burner consists of a solid brass casting F, the bottom part of which is formed into a hexagon G to fit the spanner, and a screw is cut to fit the screw collar H. A hole is drilled to meet the tube C, as shown by dotted lines at J, and another hole is drilled at K so as to run into J. Two short pieces of tube L^1 and L^2, about ¼ in.,



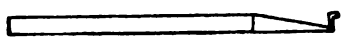
Making a Paraffin Blow-lamp.

are soldered on so as to cover up the holes in F. A piece of tube M, mitred as shown (Fig. 2), is soldered to L^1 and L^2, the dotted lines showing the position, and another piece of tube, U-shaped (N, Fig. 3), is soldered to M. A nipple O, with a very fine hole in it, is screwed into N, the tube having another piece of metal soldered to it to provide thickness for the screw thread. On working the pump, the space in the reservoir above the oil will be filled with compressed air, which will force the oil up C, through J and K into L^1 and L^2, round M, then into N, and out of the nipple O. Some of the oil is allowed to run into the hollow B, and is lighted. As soon as the burner gets hot enough to gasify the oil in the tubes the gas will issue from the nipple with a roar, ignite, and, as it passes through the centre of M, will turn the oil therein into gas, and so become self-acting. A nozzle or tube Q is attached as shown to concentrate the flame, and a handle and screw cap for filling must be added. A small air-tight tap must be soldered in the top of the reservoir so as to let the air escape when the lamp is done with. Experiment will show how much oil is wanted. If the flame is too large for general use, or if the burner gets choked by too much oil, the tube C can be pinched in a little at the bottom, or by making F a little taller a tap might be arranged for. Brass and hard solder must be used throughout.

Cleaning Floor Tiles.—For cleaning glazed terra-cotta floor tiles, a rub with a dry or slightly damped flannel is all that is necessary. Unglazed floor tiles occasionally present a white scum on the surface, caused by the evaporation of the lime and cement used in the foundations. In cases where the tiles have been laid on new foundations, this scum may continue appearing for some months. The floor is not injured by this, and the scum may be easily removed. Floor tiling should be cleaned two or three times a week with soft soap dissolved in tepid water and applied with a hand scrubbing-brush. Paint spots or similar stains, and also cement marks, may be removed by pouring on them a small quantity of sulphuric acid diluted with an equal quantity of water and allowing it to remain for a few hours. It should then be washed off and, if necessary, again applied till the stain has disappeared. For removing ink stains, use nitrous acid in place of sulphuric acid. Particular care should be taken when using these acids, as they will burn both hands and clothes. A piece of old flannel may be used for washing the acid from the tiling.

Preventing Knots showing through White Enamel.—White-enamelled articles made of cheap wood show the knots and dark parts of the grain. To prevent this, dissolve 2 oz. of pale shellac in ½ pt. of methylated spirit, then mix in some finely crushed flake white. Apply this solution to the knots, etc., with a camel-hair brush; several coats may be laid on so long as the solution is evenly distributed. Any harsh edges must be smoothed down with fine glasspaper before applying the enamel, which should not be used too thin.

Fixing Cylinder Pivots in Watch.—The cylinder of a horizontal watch is composed of a thin, polished steel tube open at each end. Into the open ends plugs are fitted, and the pivot is formed by turning the plug end smaller, and is therefore solid with the plug. When a pivot is broken, the plug is knocked out with a special punch shaped as shown below, a new one fitted, and the pivot turned and polished to fit the jewel hole. In knocking out the plug, rest the cylinder on a stake with



Punch for Removing Cylinder Plugs.

graduated holes in it. Let the brass collet rest on the stake and gently tap the punch. In most cases the plug comes out easily; but sometimes the brass collet will shift first, especially when the plug is very tight. In such a case, to start the plug use a stake with coned holes, and when once started the plain hole stake can be used; select a hole which exactly fits the plug and that will not let the cylinder body come through. To turn the pivot, warm the cylinder gently on a brass plate or over a flame and run it full of shellac; this makes it solid and firm to turn and prevents breakage. Also, if turns are used, fix a turning ferrule on by means of shellac. If a lathe is used, cement the cylinder in an ordinary wax chuck having a coned hole into which the bottom pivot of the cylinder is firmly pressed, and it is run true in the lathe while the cement is warm by means of a pointed watch peg.

Preparing a Signboard for Gilding upon.—The board should be well rubbed down with a flat piece of pumice-stone and plenty of water to efface any old writing and also to get a level surface. The rubbing should be done lightly with a circular motion. Should the stone clog, free it by rubbing two pieces together; wash off with clean water and allow to dry. For the first coat of paint, beat up ¼lb. of genuine white lead in turps, add ¼lb. of drop black, and thin to the consistency of cream with good carriage varnish and turps; this will make a dark lead colour. Lay on evenly with a ⅝ ground hog-hair brush. The mouldings may be done with a medium size sash-tool. When thoroughly dry, the board should be lightly glasspapered with fine paper; then dust off and give a coat of all drop black ground in turps thinned with varnish; allow time to dry hard, and give the final coat, which should be quite flat, made from drop black ground in turps with just enough varnish to bind the colour. This last coat should dry off without gloss. The gilding can then be proceeded with.

Hard-soldering Gold Rings.—For hard-soldering a gold ring without discolouring it, use solders containing gold, which is afterwards brought to the surface by a process of annealing and pickling. The solders are prepared to suit the quality of the gold to be soldered, so that they may "colour" well and thus hide the joint. The following is a list of coloured solders:—Best solder: fine gold, 12½ parts; fine silver, 4½ parts; copper, 3 parts. Medium: fine gold, 10 parts; fine silver, 6 parts; copper, 4 parts. Common: fine gold, 8½ parts; fine silver, 6½ parts; copper, 5 parts. The solder is cast in long ingots, rolled thin and flat, and cut up, or filed into dust, and thus applied to the cleaned joints, using borax as a flux. After the joint has been closed under a blowpipe flame, the whole ring is annealed on an annealing plate to a dull red heat, then cooled, pickled in acid, and polished. The film of grease left on by the polishing process is washed off in hot soda water, and the ring dried in hot sawdust. Hard-soldered rings may be coloured with a film of electro-deposited gold.

Bleaching Bone Grease.—Bone grease may be bleached by adding sulphuric acid and then thoroughly washing in water. Use two tanks, lined with lead, one above the other, and fitted with agitating gear; the lower tank should be fitted with a perforated steam coil. The melted grease is first run into the upper tank, and for each 10 gal. 1lb. to 1½lb. of strong sulphuric acid is added, and quickly agitated with the grease for about half an hour. The grease is then run into the lower tank, in which it is thoroughly washed with several lots of hot water and steamed. After settling, to further clear it the purified grease may be run off into a tank kept in a warm place, or the grease may be run into barrels if the presence of a small quantity of water is not detrimental.

Boehm System of Fingering for Oboe and Clarionette.—The Boehm system of fingering, which was introduced about 1846, consists in making the keys (which formerly closed by springs) open automatically, the closing being effected by means of rings round the finger holes. By adopting this device, holes can be bored in more correct positions, and the fingers are not strained by stretching. Bass fingered wood-wind instruments are also made possible. Even in the flute the holes are very far from being in their best position. In the accompanying illustration of a flute it will be seen that the lowest finger hole is too high; if it were in its right place it would be too far for the third finger to close it, therefore

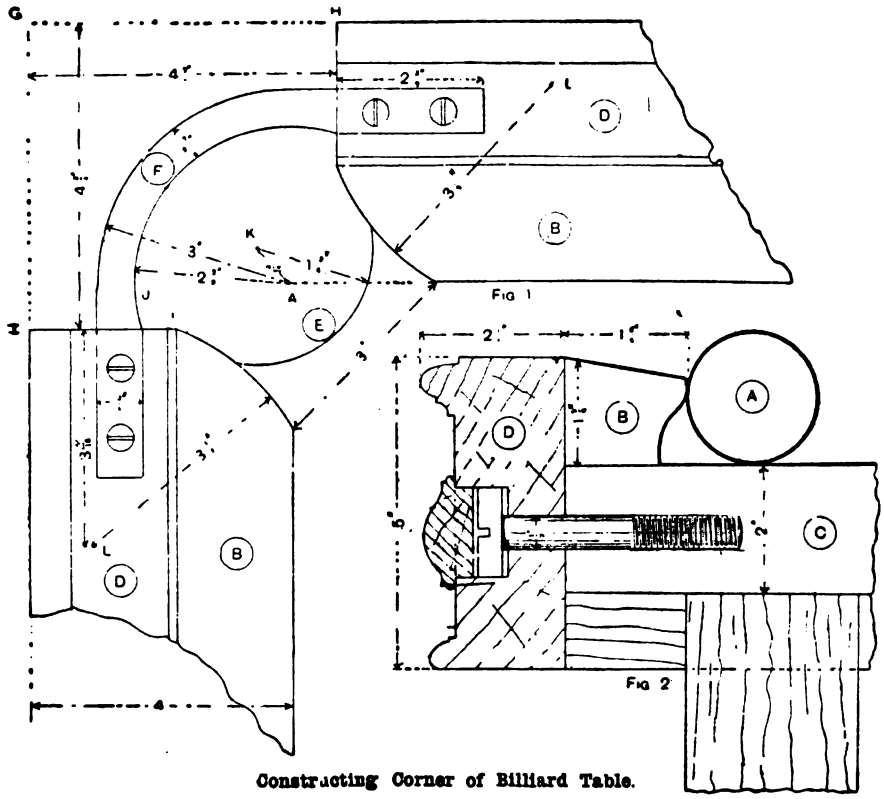
System of Fingering Flute.

it is brought nearer, and made smaller, the result being that what is gained in convenience is lost in tone. Siccama therefore made his flutes with open keys for this and the corresponding hole on the middle joint, closing them by leverage, which is brought to an easy position for both of the third fingers. Another advantage of the Boehm system is the better manipulation of the fingerings, by which the alternate opening and closing of the holes work the keys which produce the chromatic sounds. In the one-keyed flute, nearly all these sounds must be produced in this way; and even when keys are provided it is sometimes easier to use the fork or cross fingerings. Thus, left 1, 2, 3 represent the right-hand fingers, and all closed holes represent D, 1 and 2 closed E, 1 closed F sharp; the fork for F natural would be 1, 3 closed, 2 open. Now if hole 2 is bored, so that with hole 3 open it makes a good F sharp, it by no means follows that the closing of 3 will enable the open hole 2 to produce a true F natural. By the use of a small auxiliary hole, and rings round 2 and 3, both sounds can be made perfect. If the Boehm system could have been adopted in its entirety, self-closing keys would have been superseded by self-opening keys; but that being found impracticable, the system has been modified, and is partially applied to very many instruments, one of the most advantageous being Barrè's improvements for oboes and clarionets. It is really a combination of old and new systems, whereby a lever allows the self-opening keys to act, while they are closed by rings round the proper holes when they must be shut.

Solution for Electro-silvering.—To make a good silvering solution, procure 2oz. of the best crystallised silver nitrate and dissolve it in 1 qt. of distilled water. Also procure 2oz. of best potassium cyanide and dissolve it in 1 pt. of distilled water. Add this a little at a time to the silver nitrate solution, and stir well each time with a glass rod until no white curdy precipitate is caused by the addition of a few drops. Allow the white curds to well settle down, then pour off all the liquid. Pour on clean water, allow the curds to settle again, and repeat the process several times; finally, drain off as much of the water as possible. Dissolve these white curds in a solution of potassium cyanide and add a little surplus to make it work freely. Use anode plates of pure silver, and work cold in a stoneware or glass vessel with current from two Smee cells, or from two or three Daniell cells.

Making Portland Cement Wash.—To make a Portland cement wash of a light stone colour, first spread the cement dry on the floor for five or six hours, then well mix with water in a large tub. The consistency must be judged by the condition of the wall to which the wash is to be applied. To every 5 gal. add 1 qt. of soluble glass; keep well stirred when using. This will make a grey stone colour, but not that known in London as stone colour.

Constructing the Corner of a Billiard Table.—Fig. 1 shows the plan of the corner, the figured dimensions indicating how it is produced. The outer lines are at right angles, the inner lines are parallel with it, A being the intersecting point of the inner, and G of the outer. From point G mark off 4½ in. on each outer line to H, and a line 2½ in. long square with it to I. With point A as centre, and the radius A J, inscribe the segment forming the inner edge of the pocket-holder F. With point K as a centre and a radius of 1½ in., inscribe the segment E forming the corner.



Constructing Corner of Billiard Table.

With point L as a centre and a radius of 3½ in., inscribe the arc forming the cant of the cushion. B is the cushion, D the rail, F the brass pocket-holder let in flush with the top edge of the rail. Fig. 2 is a section through the rail showing the slate bed and its screw: the cushion B is termed the low cush, the ball A standing well above it to enable the player to strike near the centre. The cord pocket (see Fig. 1) hangs from the holder F on one side and is fixed underneath the bed at the curve E. The cushion is fixed with either screws or glue.

Gas Fire Roaring.—The roaring of a gas fire is generally due to some roughness in the interior of the burner, caused either by a burr in the tube or by an accumulation of deposit, the result of the burner firing back. This is often found to be a source of the trouble.

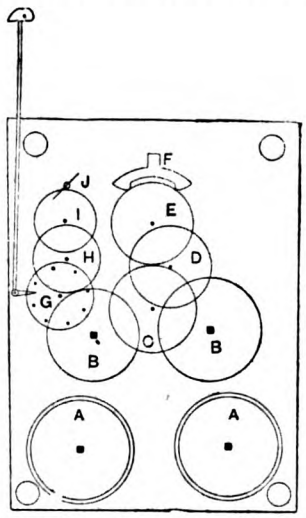
Speculum Grinding.—In rough grinding, use flour emery until all the pits left by the coarse grains are worked out. The surface of the speculum will then appear quite uniform when examined with a magnifying lens of about 1-in. focus. The fine grinding is then commenced. A good way of judging when the process of fine grinding is completed is to hold the speculum in such a position that a gas flame is seen by oblique reflection in it; then gradually increase the angle of incidence until the image grows dim. By slightly tilting the mirror the image may be made to pass over every part, and should appear equally though feebly illuminated in every position. Another method is to hold the mirror horizontally, about level with the eye; then, when looking along it at the window, no greyness should be visible. The glass is now ready for polishing. The more thoroughly the fine grinding is done, the less polishing will be necessary and the less injury will be done to the figure in the polishing. What is known as the shadow test is applied continually when figuring and polishing. Sometimes the speculum becomes tightly locked with the tool during the process of fine grinding, and this may be explained as follows:—As the upper disc moves along the lower one there is a tendency to heap up the emery towards the centre and away from the edges. This makes the convex tool slightly flat, and the concave speculum slightly hollow in the middle, thus leaving an empty space between them. After a time the film of moisture between them becomes exceedingly thin, a partial vacuum forms in the centre, and the two discs become locked together. The chances of such mishaps may be lessened by dividing the surface of the tool into parallel grooves 1 in. apart and at right angles to one another. To make these grooves, first mark them out with an American glass-cutter and then deepen them with a steel graver, keeping the part wet with turpentine.

Obscuring Glass with Acid.—Glass may be obscured by first laying it flat and then holding some thin strips of glass 1 in. wide on edge, and painting round with hot tallow. When this sets it will form a wall all round the glass, and keep in the acid; or paint a band round the glass with two or three coats of hot tallow. Now pour on white acid, and let it remain until the glass is matted.

Bringing Watch to Time.—To bring a watch "to time" means to make it keep correct time. To do so with a *good* watch, the curb pins must first be closed until the hairspring has no play between them. Then regulate by lengthening or shortening the hairspring, the regulator meanwhile being kept in the centre. Shortening the hairspring makes the watch go faster and *vice versa*. After each alteration of the hairspring, the watch must be set in beat afresh by turning the hairspring collet round a little.

Polishing and Cementing Alabaster.—After washing, melt a little white beeswax, dip a clean cloth in it, and polish the ornaments with the cloth. The best cement for mending alabaster is white gelatine size, made by melting 1 part of gelatine in about 5 parts of water. Plaster-of-Paris is very often used as a cement, but only in places where the joints would not be seen, and it is not a strong cement.

Making Eight-day Movement for a Lantern Clock.—The frame should be made of brass plates ⅛ in. thick, and should measure 4¼ in. by 6 in. The pillars (four) must be ⅜ in. diameter and 1⅜ in. long between the plates. The barrels should be 1½ in. diameter and 1½ in. long. For going train, use fusee main wheel of 96 teeth, 1¼ in. diameter; centre wheel of 84 teeth, 1⅜ in. diameter, pinion 8 leaves; third wheel of 78 teeth, 1⅛ in. diameter, pinion 7 leaves; 'scape wheel of 40 teeth, 1¼ in. diameter, pinion 7 leaves. For motion work, use minute wheels of 36 teeth, ⅜ in. diameter; hour wheel of 72 teeth, 1½ in. diameter; minute pinion, 6 leaves. For striking train, use fusee main wheel of 84 teeth, 1⅜ in. diameter; pin wheel of 64 teeth, 1⅛ in. diameter (eight pins), pinion 8 leaves; pallet wheel of 70 teeth, 1 in. diameter, pinion 8 leaves; warning wheel of 60 teeth, ⅞ in. diameter, pinion 7 leaves; and fly pinion, 7 leaves. Either chains or gut lines can be used, but chains are best. The fusees must be cut for sixteen complete turns of the chains. On account of the small size of the movement, it can carry a light hammer spring only. The pendulum will make 178 beats per minute, and will be of 4·3 in. acting length, which, with a 2-in. diameter brass bob, and allowing for suspension, will measure nearly 6 in. long over all, and just swing clear of the bottom of the case. The pendulum should be provided with the rating nut above the bob, after the usual pattern of English bracket clocks, and thus save the space occupied by a nut under the bob. The centre pinion, when made from pinion wire, is thickened at the front end by having the leaves at that part forged up solid. This method will be almost impossible in so small a clock as this, and if pinion wire be used, it would be advisable to drive on a steel collar to form the shoulder of the front pivot. In the accompanying sketch, A A are the barrels; B B, the fusees; C, centre wheel; D, third wheel; E, 'scape wheel; F, pallets; G, pin wheel; H, pallet wheel; I, warning wheel: and J, fly.

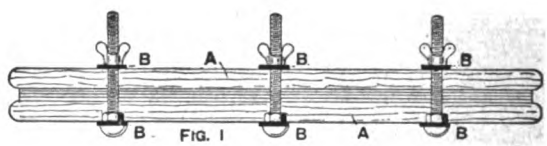


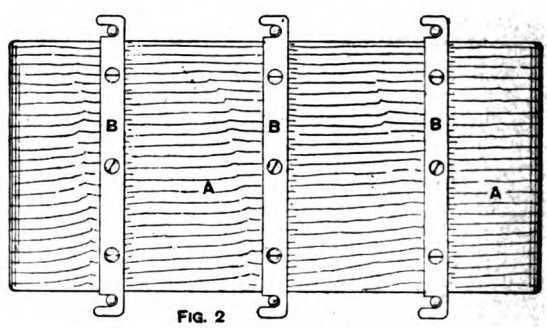
Eight-day Movement for a Lantern Clock.

Preparing Creosoted Timber for Painting.—Painters' knotting is a good material for coating creosoted poles and other wood previous to painting, because it dries quickly and tends to prevent oil or grease oozing through. The best kind of knotting will be that made from shellac; the commoner material will contain more or less common resin.

Solution for Electro-gilding.—For gilding small goods by the electro process, place a pint of distilled water in an enamelled iron saucepan and dissolve therein 1 oz. of best potassium cyanide. Heat this to 160° F. on a gas stove. Get two strips of pure gold and two lengths of No. 22 copper wire, and suspend the gold strips by the wires in the hot cyanide solution; then connect the wires to the battery and allow a full current to pass through the solution, from one gold strip to the other, for about two hours. Then take off that gold strip which is attached to the wire from the zinc of the battery, and substitute a strip of clean German silver. If this takes on a good coat of gold in a few seconds, the solution is in working order, and the two gold strips may then be both attached to the wire from the silver, copper, or carbon of the battery and used as anodes. If the coating is not satisfactory, dissolve some more of the gold as at first, until the solution will gild well. The same solution may be made at once by the direct process—that is, by dissolving ½ oz. of gold cyanide in the hot cyanide of potassium solution. These gold solutions gi e good results when worked at a temperature of from 140° to 160° F., and will give a good coat of gold with current from one Smee cell when an anode (or dissolving plate) of pure gold is employed.

Making a Trousers Press.—Figs. 1 and 2 show elevation and plan respectively of a simple trousers press, A A being two flat boards 14 in. wide and about 30 in. long. Three iron bars B are screwed on each board. The bars on the top board are hooked at their extremities, as shown in Fig. 2, to allow the board to be removed without taking off the wing nuts. In Fig. 2 the wing-nuts are removed so as to show the slots. The bars on the under board are not hooked, but have holes at their extremities to receive coach bolts, which should be fixed with screw-nuts before the bars are fastened to the board. When the bars are fastened to the boards, the top board can be screwed down with wing-nuts. A sheet of thick cardboard should be placed between each pair of trousers before pressing them.





Trousers Press.

Golden Brown Paint for Castings.—To obtain a rich golden brown colour on castings, mix the colour with the best copal or carriage varnish, adding gold size. Paint the castings in the usual way, and then stove them. Or another method would be to paint them with the colour required rubbed up in oil and with gold size, and then varnish with best varnish.

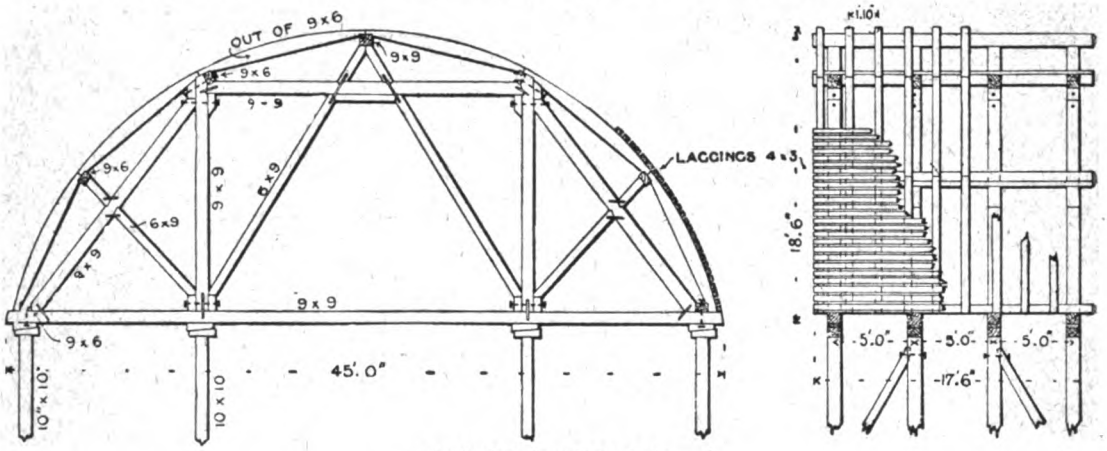
A Bucket as a Photographic Print Washer.—To make a cheap syphon washer that will keep photographic prints in circular motion, to one side of a bucket solder a syphon of ordinary lead piping, the short leg inside being 1 in. above the bottom. At the top of the syphon punch a hole and fit a cork. Fix in a circular sheet of perforated zinc inside the bucket 3 in. from the bottom. At the top of the bucket opposite the syphon attach another pipe, connected with the ordinary water tap by rubber tubing, through which the water flows. This keeps the prints moving. The contaminated water falls below the perforated disc and is removed by the syphon. When the cork of the syphon is in, the washer will run dry, but in use the cork should be removed, so that, in the event of any obstruction or failure of the water supply, the washer will remain filled level with the cork-hole. The edges of the zinc must be bent downwards, as there must be no sharp edges to come in contact with the prints.

Hard Woods and Soft Woods Classified. — It is customary in England to speak of all timber obtained from coniferous trees as "soft wood." Pitch pine is, of course, much harder than a number of the so-called "hard woods," but it would nevertheless be classified as a "soft wood." Much better is the system adopted in some parts of America, where four grades of hardness or softness are recognised—namely: "Very hard woods," "hard woods," "middling hard woods," and "soft woods." The names of a few familiar woods will illustrate its application :—

V. H. Woods.	*Hard Woods.*	*M. H. Woods.*	*Soft Woods.*
Hickory.	Ash.	Pitch pine.	Pine and fir.
Hard maple.	Black walnut.	Douglas fir.	Redwood.
Locust.	Beech.	Larch.	Poplar.
Best oak and elm.	Oak and elm.	Sweet gum.	Whitewood.
Persimmon.	Lacewood.	Light birch.	Cypress.

The classification is arrived at by the amount of power required to indent a square inch of the surface of the wood to a given depth.

Centering for Brick Arch.—A figured design of a centre for a seven-ring brick arch of 45 ft. span and 18 ft. 6 in. rise, the length of the arch being 17 ft. 6 in., is here given. It is assumed that the centering has only to carry the arch bricks. It should be very carefully put together, as there is no surplus strength in an arch of these dimensions.



Centering for Brick Arch.

Refining Impure Tin.—In refining impure tin, melt the metal, well stir it about while in a molten state, and allow it to settle down for a while. Skim the dross from the surface, and remove the top half of the molten metal with a small ladle, disturbing the lower part of the metal as little as possible; use only the part of the metal removed for the best work.

Tinning Copper Moulds.—A bright, smooth, but very thin deposit of tin upon the interior of an ornamental mould may be obtained by first thoroughly cleaning the mould, then placing the open end upwards in boiling water and fastening it so that the edges are not quite immersed. In sufficient water to just fill the mould dissolve about an ounce of cream of tartar. Melt some tin in a ladle and pour it into cold water, so as to obtain it in spongy fragments. Place some of these in the cream of tartar solution, then pour the mixture into the mould. Boil the water in which the mould is placed for about an hour; the interior will then be found to have received a fine silvery, though thin, deposit of tin. Probably a bright, smooth surface and thicker coating could be obtained by first tinning the mould by the regular process, and afterwards standing it bottom downwards in Russian tallow, which is kept heated to a temperature a little above the melting point of tin; the tin would then probably melt and run smoothly over the tinned surface (in the same way that it does upon tinned iron plates), and leave a surface for polishing of a similar character.

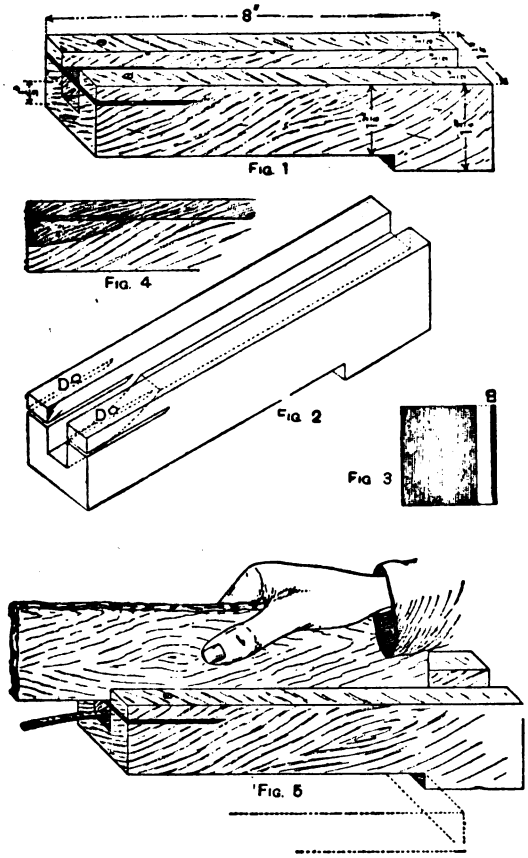
Petersburg Standard of Timber. — A Petersburg standard is 1 0/12 ft. 11 in. × 1¼ in. = 165 ft. cube. To ascertain the number of feet run of any sized scantling required to make a standard, multiply 1,440 by 16·5, and divide the product by the sectional area in square inches of the required scantling, the quotient being the number of feet. Taking 9 in. × 2 in. as example: (9 × 2 = 18). Then 1,440 × 16·5 ÷ 18 = 1,320. The following table includes the most general sizes; others can be worked out as above:—

Size.	*Foot Run.*	*Size.*	*Foot Run.*
4 × 2	2,970	4 × 2½	2,376
4 × 3	1,980	4½ × 2	2,640
5 × 2	2,376	5 × 2½	1,900⅘
5½ × 2	2,160	6 × 2	1,980
6½ × 2	1,827 3/11	7 × 2	1,697⅐
7 × 2½	1,357⅐	7 × 3	1,131⅔
8 × 2	1,485	8 × 3	990
9 × 2	1,320	9 × 3	880
9 × 4	660	10 × 2	1,188
10 × 3	792	11 × 2	1,080
11 × 2½	864	11 × 3	720

Intensifying Photographic Negatives.—Dulness in a photographic negative is generally due to fog, caused by over-exposure, incorrect development (*i.e.* using too much No. 2), or accidental exposure to light. If the negative is fairly transparent, soak it in water for a few minutes, and then immerse it in a saturated solution of bichloride of mercury until it begins to bleach to a cream colour. Wash for fifteen minutes, and then place in a clean dish, film up, and pour over it a solution composed of 2 oz. of water and thirty minims or drops of strongest liquor ammonia. The negative will instantly turn black (or it should be allowed to remain until it does). This operation is called intensifying: it increases the density and contrast of the negative. As the ammonia solution in careless hands is liable to produce stains, due to insufficient washings, some people prefer to use a saturated solution of sulphite of soda, with which very little washing is required between bleaching and blackening; but the density obtained is much less, partly owing to the blue colour of the deposit. Allowance for this should be made by bleaching thoroughly. The following formula may also be used after thorough washing, and gives a red image of great contrast:—Uranium nitrate 100 gr., potassium ferricyanide 100 gr., acetic acid ½ oz., water 10 oz. Rinse only and dry. Wetting the negative, pressing it between blotting-paper to absorb surface moisture, immersing in methylated spirit for ten minutes, and then drying by gentle heat, clears the shadows and gives greater contrast. Of course, if the dulness arises from a want of sharpness, the above is of no service, and the only remaining plan is to work over it with the retouching pencil, but this is a long and tedious process in most cases.

Cleaning Copper Utensils after Tinning.—It is doubtful whether there is any solution that would cleanse both the copper and tin from the dirt left from the tinning process without injuring either metal. The usual method of cleansing tinned copper vessels is to thoroughly scour them inside and out with sand and water or with any fine gritty substance until the whole of the surface is rendered clean, then rinse in cold water and dry the article in sawdust.

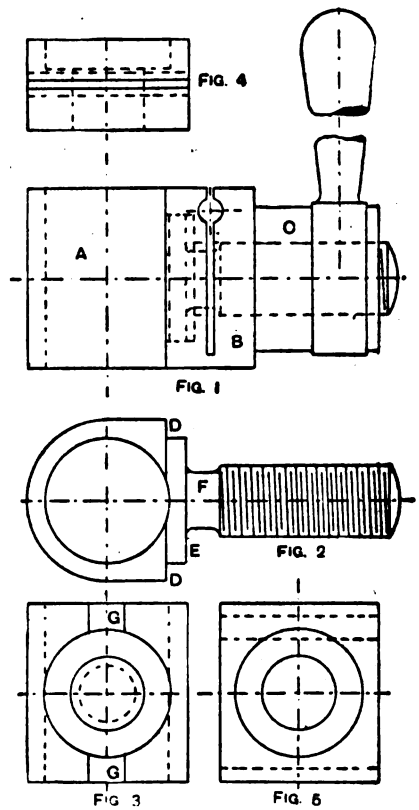
Making a Spill Cutter.—To make the spill cutter here described and according to the dimensions given in Fig. 1, a piece of wood some 8in. by 1½in. by 1½in. must be obtained, and a groove about ¼in. wide and ¼in. deep cut along the centre of one of its broad sides. At one end this groove is further hollowed out as in Fig. 2, which shows the shape of the groove and also illustrates the slits, 2in. long, in which the knife is to be fixed. Now cut from the bottom a strip of wood some 6in. long and ¼in. thick, so as to leave a piece projecting from the under side at the rear end as shown in Figs. 1, 2, and 5. The knife itself is a piece of steel 2in. long and 1¼in. wide, into the sides of which two holes have been drilled as indicated in Fig. 3. The edge (see side elevation B, Fig. 3) is ground sharp just like a chisel, after which the knife is placed in the slits previously cut in the block. Then find the correct positions for the holes D D (Fig. 2) in the wood, through



A Handy Spill Cutter.

which pass the screws which hold the knife securely in its place. At Fig. 4 is given a section which illustrates the position of the knife, the cutting edge of which is raised about ⅛in. above the bed of the groove. The cutter, being finished, may be put to work. First place the projecting under piece against the edge of the table, as shown in Fig. 5. A piece of straight grained wood being pushed sharply forward through the groove, its bottom edge strikes against the slightly raised blade, and a spill issues from the aperture beneath the knife. By means of such a tool, spill making becomes astonishingly easy, and a large number can readily be cut in a very short time.

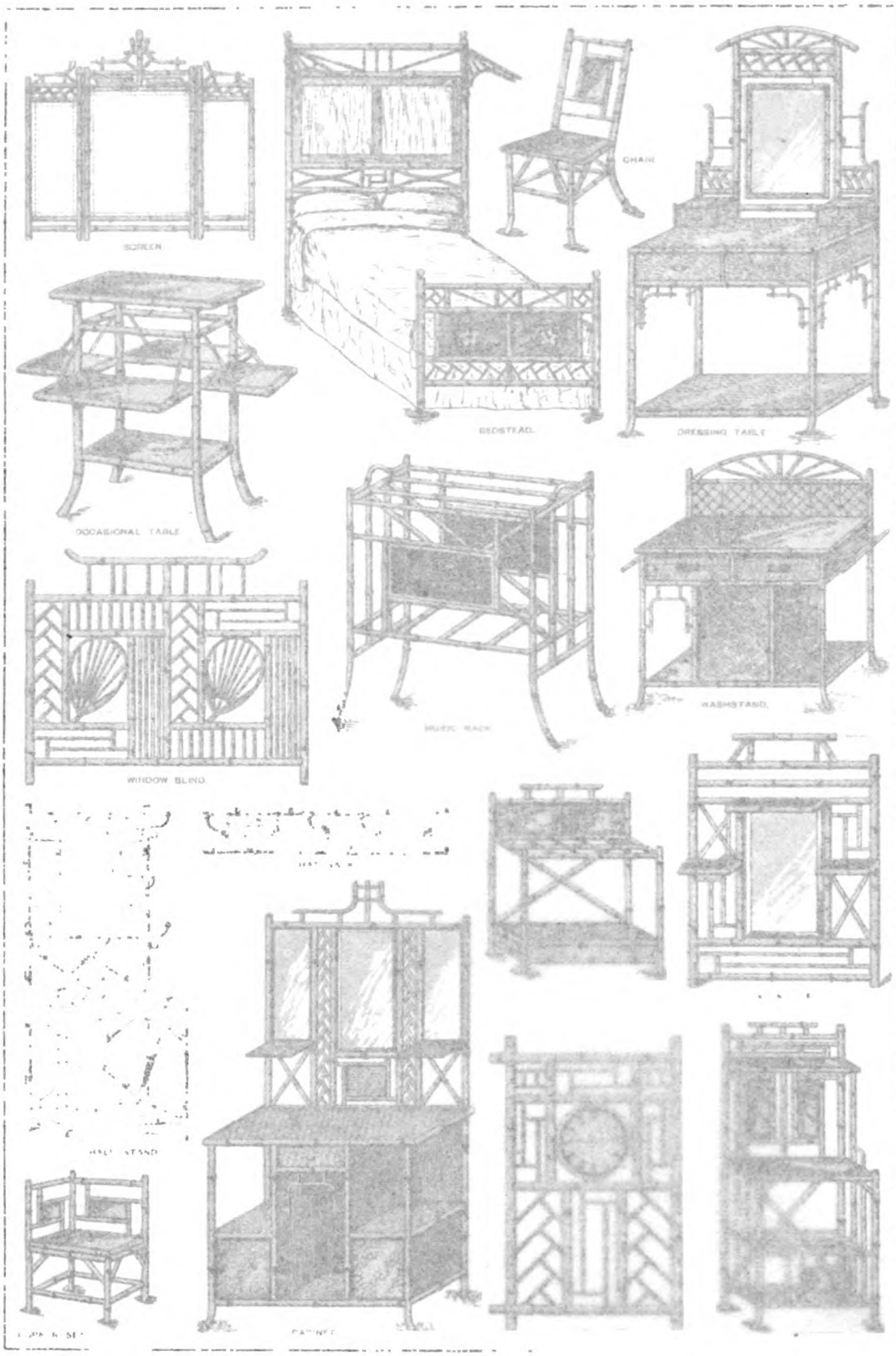
Clip for Engineers' Scribing Block.—The accompanying illustrations show a form of scribing block clip greatly in favour a few years ago, simply because turning, rather than fitting, was principally required. Fig. 1 shows the clip complete in elevation. It consists essentially of three pieces, the clip itself A, the square washer B, and the handle C. The clip is shown in plan by Fig. 2, and in end elevation by Fig. 3. It may be made from square steel, drilled with a twist drill at one end to fit the post, this end, the left in Figs. 1 and 2, being rounded off to suit. The sides of these holes having been faced on a mandril in the lathe, these edges can be placed on any true surface, and centre lines scribed across at the ends. Or the piece can be placed on a mandril, and, the rounded end being centred, the ends of the mandril resting in V-blocks, the point of a knife tool is set to the mark, the tool withdrawn by the bottom slide only, the piece turned round, and the point of the tool moved up to mark the other end. The top slide must not be moved in these operations. Of course, the ends should have been prepared for scribing previously by filing and chalking. This method will ensure that the turned and threaded part shall be square with the hole, the mandril and a packing piece under the shank end being used in drawing the cross centre lines. The rest of the work presents no difficulty, but the face at D (Fig. 2) should be turned back just past the hole, a collar being formed at E. The turning down of the



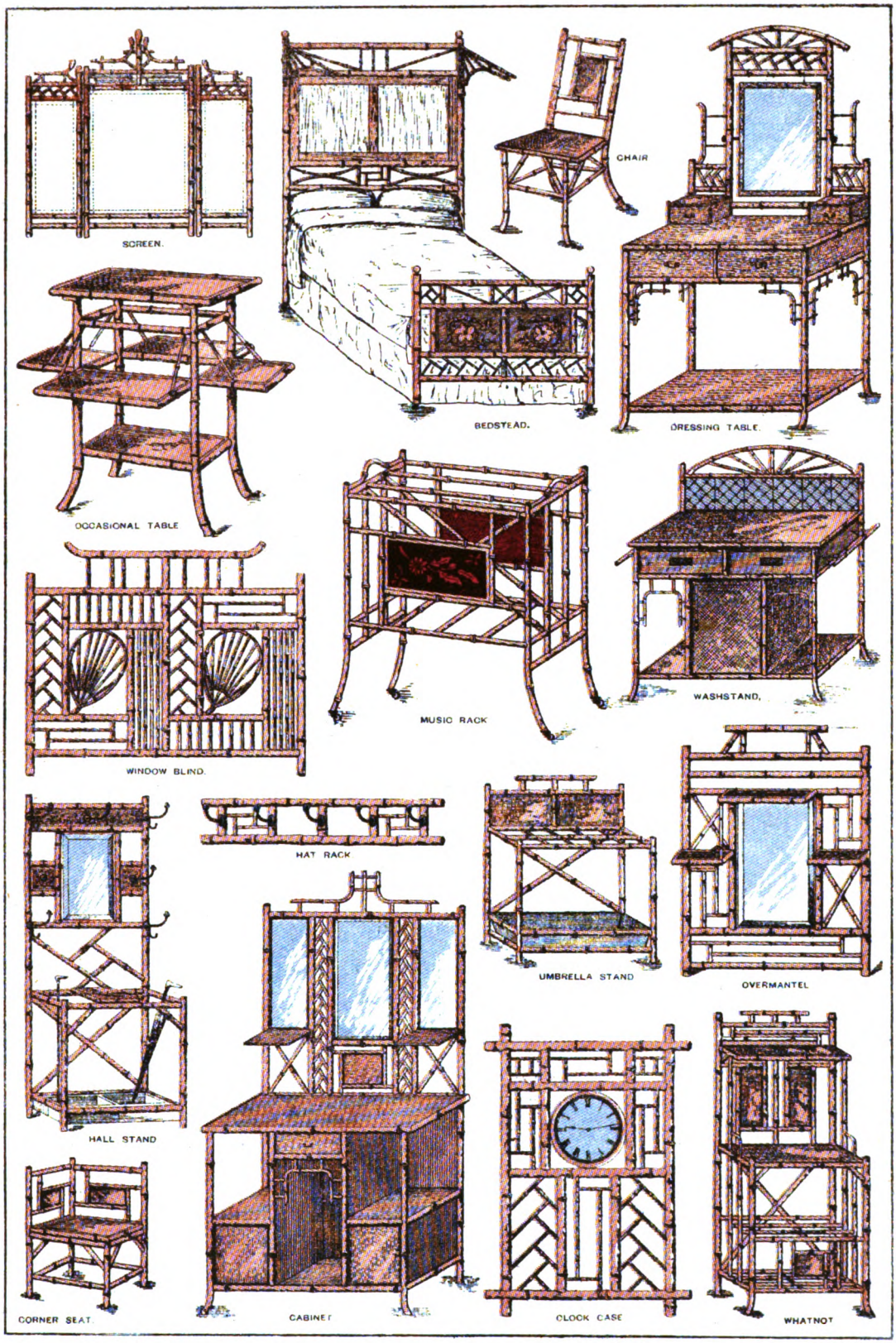
Clip for Engineers' Scribing Block.

shank at F is for ease in chasing the thread. G (Fig. 3) shows the slots left by the turning back at D (Fig. 2). Fig. 4 is a plan, and Fig. 5 an end elevation of the washer. The outer surface of this corresponds with the shape of the large end of the clip, and a recessed hole is bored in it, the larger end fitting on the collar E (Fig. 2), while the small hole slides over the threaded end of the clip. The washer is slit down the centre nearly but not quite to the bottom, a hole for the scriber having previously been drilled across as shown at the top of Fig. 1. The handle C (Fig. 1) is threaded to fit the screwed end of the clip. The cross section of the boss and of the handle itself is circular. The washer also may be circular instead of rectangular, and will then work easier on the post.

Cementing Amber Mouthpiece.—When a broken amber mouthpiece of a tobacco pipe requires to be jointed, touch the broken parts with boiled linseed oil, and hold them for a few minutes in a gas flame; place them together, and bind with wire. Lay aside for a few days for the cement to harden, and pare off the excess with a sharp knife.

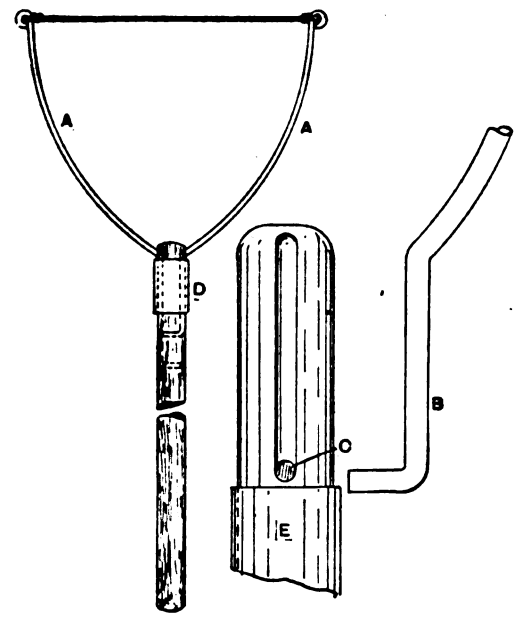

SCREEN
CHAIR
BEDSTEAD.
DRESSING TABLE
OCCASIONAL TABLE
WINDOW BLIND.
WASHSTAND.

BAMBOO WORK


SCREEN.
CHAIR
BEDSTEAD.
DRESSING TABLE.
OCCASIONAL TABLE
MUSIC RACK
WASHSTAND.
WINDOW BLIND.
HAT RACK
UMBRELLA STAND
OVERMANTEL
HALL STAND
CORNER SEAT.
CABINET
CLOCK CASE
WHATNOT

Giving an Ivory Appearance to Plaster Casts.—Over a slow fire melt ¼lb. of beeswax with 1 pt. of turpentine, and apply to the plaster by means of a soft brush. Several successive coats are necessary to cover the plaster well. If the mixture is too thick, add a little more turpentine. Plaster casts may be coloured by including a tint in the wax and turpentine.

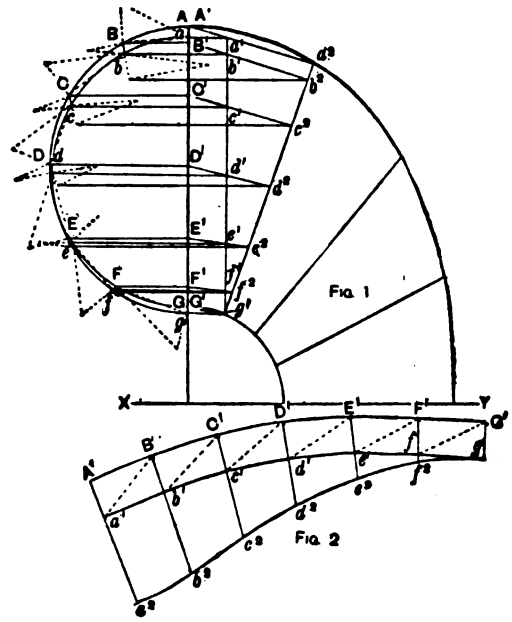
Making a Fisherman's Landing Net.—The illustrations show a simple frame for a landing net as used by anglers. The two side pieces A A are made of No. 7 B.W.G. steel wire, the outer ends being turned to form an eye. The ends that fit on the stick are bent at right angles for ½in., as shown at B. One of these should be longer than the other, as they would weaken the stick if they came opposite. A hole C is bored on each side to take the turned ends of the wires, and the stick is grooved so that each wire will fit in flush. A cord is stretched across between the two eyes, and this completes a D-shaped bow on which the net is threaded. To hold the frame on the stick, a loose ferrule D is slipped up, or a lashing may be used instead if preferred. To take the net to



Making a Fisherman's Landing Net

pieces, the ferrule is slipped back to the position shown at E, when the wires may be removed and the net rolled round them. The stick may be made of greenheart or hickory.

Pattern for a Ship's Ventilator.—To cut the pattern for a ship's ventilator in four pieces, first draw a side elevation of the required size, then divide the throat curve into a number of equal parts, corresponding to the number of sections required for the ventilator. Next divide the top curve, forming the top of the ventilator into the same number of equal parts used for the throat, and also draw the semicircle A G (Fig. 1). Join the division points on the throat and top curve by straight lines; these would show the four sections whose patterns are to be developed. As the method of working would be the same for each section, the method adopted for the section A G, $a^2 g^1$ (whose half-pattern is shown by Fig. 2), could be applied for developing the remaining three sections. A very near approximation to an accurate pattern is obtained by assuming that each section is a part of an oblique cone, and if this be done, the semicircle A G (Fig. 1) would be the half-plan of the base of an oblique cone containing the first section. Now join A a^2 and G $^1 g^1$, and also draw a line from g^1 parallel to A G to cut A a^2; then this line could be assumed to show the smaller end of the frustum of the cone on the elevation. Draw projectors from a^1 g^1 to join A G, and with half this length as radius draw the semicircle a g to show the plan of the small end. Next divide the semicircles into a similar number of equal parts as A, B, C, a, b, c, etc. From the division points B, C, D, E, F draw projectors to A G^1, and from b, c, d, e, f draw projectors to join $a^1 g^1$. Join $B^1 b^1$, $C^1 c^1$, $D^1 d^1$, $E^1 e^1$, $F^1 f^1$, and produce these lines to join $a^2 g^1$ at b^2, c^2, d^2, e^2, f^2. Join the division points on the plan by straight lines, and from b^2, c^2, d^2, e^2, f^2 draw projectors to join the lines with corresponding letters on the plan, and if a curve were drawn through the points found, that curve would show the plan of the section of the ventilator on the line $a^2 g^1$. Join the division points a B, B c, C d, D e, E f, F g by a series of dotted lines, as shown, and these would be the plans of a series of diagonals joining the points indicated. Next find the true slants of the stripes and diagonals by drawing lines at right angles to B b, C c, D d, E e, F f, and on the lines drawn at right angles mark the upright height g g^1, as shown. Join the division points on the inner circle to the points marking the upright height, and this would form a series of triangles; the slant length forming one side of the triangle would be the true slant of the line on the cone in each case. Next find the true slants of the dotted diagonals by the same method, using the same upright height as for the slants. The hypotenuse of the triangle formed in each case would be the true slant of the diagonal. To find the true slants of the lines above $a^1 g^1$, where the projectors



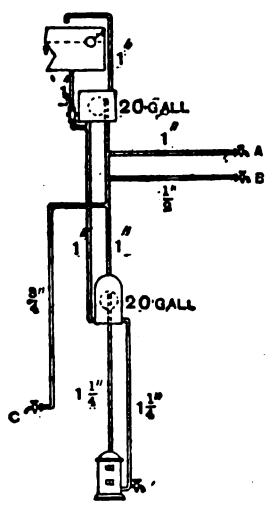
Pattern for a Ship's Ventilator.

drawn from b^2, c^2, d^2, e^2, f^2 join the lines with corresponding letters in plan; draw lines from the points found at right angles to the plan lines, and on these lines mark off the perpendicular height of b^2, c^2, d^2, e^2, f^2 when measured from the line $a^1 g^1$. Now join b, c, d, e, f to their respective upright heights, marked on each right angle to obtain the true slants of the lines produced to cut $a^2 g^1$. To work the pattern, mark on a straight line the length A $^1 a^1$ (Fig. 1). With the true length of the diagonal joining a to B as radius, and using a^1 (Fig. 2) as centre, draw an arc; with the division length A B as radius and A^1 (Fig. 2) as centre, cut the arc first drawn. Next, with the true slant of the line B b as radius, and using B^1 on the pattern as centre, draw an arc. With the division length a b as radius, and a^1 on the pattern as centre, cut the arc last drawn at b^1; this would give the points A^1 a^1, B^1 b^1 on the pattern. The remaining points are obtained by repeating the working for each division, using the slants and diagonals in their proper order for obtaining the points C^1 c^1, D^1 d^1, E^1 e^1, f^1 F^1 to complete the top part of the pattern. Join the points A^1 a^1, B^1 b^1, etc., on the pattern by straight lines, and produce them below the inner curve, then add the length a^1 a^2 (Fig. 1) from a^1 to a^2 on the pattern. Transfer the true slant of the line b^1 b^2 (obtained from the triangle drawn on the plan) to the pattern, marking from b^1 to give the point b^2; transfer the remaining true slants to the stripes with corresponding letters on the pattern, and draw a curve through these points to finish the half pattern for one section. By repeating the method of working shown for each section, the pattern for the complete ventilator would be obtained. Allowances for hollowing, seams, etc., must be made to the pattern as shown.

Amount of Rainfall on Roofs.—In estimating the size of gutters on internal roofs and behind parapet, the amount of rainfall should be provided for. An exceptional rainfall is about ·05 in. per minute, and this gives about ·026 gal. for each square foot of catching surface. An average rainfall in London would be about one-third of the above, but for preventing gutters on internal roofs, or behind parapet walls, overflowing inside the house, the maximum should be allowed for.

Quantities of Cement and Slag in Concrete.—The amount of cement and slag required for laying 100 super. yd. of floor, 1 in. thick, in the proportion of 1 to 1, is as follows:—The cubic contents of the concrete when laid will be 900 super. ft. × $\frac{1}{12}$ ft. = 75 cub. ft. There will be required about 2 cub. yd. of slag, broken small enough to pass through a ¾-in. ring, and 5¼ cub. ft. of cement (at 90 lb. to the cubic foot) = 45 cwt. This 108 cub. ft. of cement and slag will shrink to about 75 ft. when mixed and wetted.

Cylinder-tank System Hot-water Supply.—In the sketch, A indicates the bath tap, B that for the lavatory, and C that for the scullery. The sketch shows a well designed and proportioned apparatus on the cylinder-tank system. The boiler (dome-top kind) should be a No. 3. A smaller size would do, but small boilers do



Cylinder-tank System Hot-water Supply.

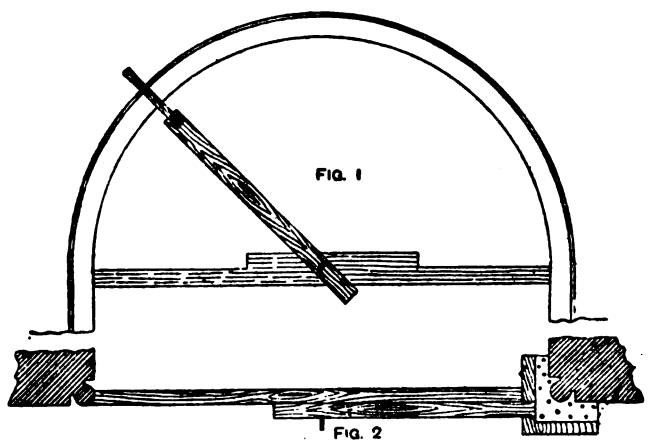
not take a sufficient charge of fuel, and they therefore need more frequent feeding and attention than large boilers. If hard water is used, the boiler should have the water-way carried below the fire-bars, and be provided with cleaning holes and lids.

Hints on Enamelling.—To treat white enamel to prevent it setting too quickly, it should be thinned with the same varnish as is used in making it. To enamel successfully, get a good flat ground to work upon, and do not try to improve the work by giving a second coat of enamel if the first does not turn out well. Never put a bright on a bright; the correct way is to finish a gloss on a flat, or a flat on a gloss. In the case of spoiled work, the work should be rubbed down with ground pumice-stone, flatted, and then enamelled again. Enamelling should be done in a warm room All enamels become ropy if exposed to the air; keep well corked, therefore, and pour out for use only a small quantity at a time.

Painting a Staircase Wall.—In repainting a staircase wall, representing about 120 sq. yd., to a shade of green, if the colour, etc., is procured from a colour merchant (not an oil shop) the quantities and the cost will be as follows:—24 lb. of white lead, cost 5s.; 2 lb. of patent dryers, cost 8d.; 1 lb. of deep lemon chrome, cost 1s.; 3 lb. of deep brunswick, cost 2s.; 2 oz. of drop black, cost 3d., all ground in oil; 3 qt. of linseed oil, cost 1s. 6d.; and 3 qt. of turpentine, cost 2s. The white lead, dryers, chrome, black, half the green, and 1 qt. of oil should be mixed well together, after which small quantities of the reserved green should be added until the desired shade is obtained. The paint should be mixed lighter than the sample, as it will dry darker. Divide the mixed colour into two equal parts. Thin one part with the oil so that it works freely, and spread on the wall evenly; twenty-four hours afterwards apply the remaining portion of the colour, thinning with turpentine so that it works freely and covers well. The time is an important item; if the interval is more or less than twenty-four hours the second coat will be sheary—that is, bright in some places and dull in others. If the last coat is stippled the result will be a better job. To stipple is to dab the surface all over with a flat brush: this takes out the brush marks. Commence at the top and work downwards. There may be a little colour left over.

Making Imitation Tortoiseshell.—A very good imitation of tortoiseshell can be made by colouring a portion of the pasty celluloid with a brown or yellow dye soluble in spirit (aniline colour), and then working the dough along with some nearly colourless celluloid. As the two are not properly amalgamated, streaks and patches of colour appear throughout. Considerable experience, however, is required.

Running Return Bead round an Arch.—To work a return bead round the arch shown by Fig. 1, a mould is prepared to the required shape, and fixed to a radius rod, as shown in Fig. 2. The flat part of the wall is roughed in, and the bead is run in coarse stuff by the aid of the mould, which also works a part of the soffit, the rest of which between the two beads is done with the floating rule. After all the work has been roughed in ready for the fining coat, the mould is readjusted so as to be in position to work the finished bead, which is usually done in Keene's cement. The part of the bead



Running Return Bead round an Arch.

below the springing line is done by detaching the mould from the radius rod, and using it in the ordinary way; while in cheap work the bead round the arch is sometimes worked without the aid of the radius rod. The walls are then finished off, the bead is run, and the soffit of the arch completed as in roughing out.

How to Copy a Glass Positive.—When copying a collodion positive mounted on glass and varnished at the back, the first proceeding is to remove the varnish. It may be possible to do this by placing for a short time in a dish of methylated spirit and then wiping down with a tuft of wool. Try one edge and see whether the picture is affected. When the varnish is removed, a print or transparency can be made by contact in the usual pressure frame. A better plan would be to pin the picture to the wall with drawing pins, and copy through the camera in the usual manner. To obtain a copy the same size as the original, it may be necessary to make a conical front, place two cameras together, or otherwise increase the extension, which should be twice the focal length of the lens. Copying is merely photographing a picture at close quarters. The only difficulty is to avoid the reflection of bright objects in the shadows and the picture. Slow plates should be used, and a strong pyro-soda developer.

Underglaze Colours for Biscuit Ware.—Underglaze colours are applied direct to the biscuit ware, and are therefore under the glaze that is applied after colouring. The coloured ware should be heated to the same temperature as in burning for biscuit, but the different colours may require different times, which will be found by experience. Time is not very important, however, as the colours are, to a large extent, fixed by a short heating, because they usually contain fusible materials.

Working a Ship's Log.—The speed of a ship is ascertained by the "patent log" or by a "log ship" and sand glass, the latter still being preferred by most sailing ship masters. The "log ship," two forms of which are given in Figs. 1 and 2, is hove over the weather quarter attached to the log line divided into "knots," a "knot" bearing the same proportion to a mile as the sand glass running in seconds does to an hour. Sand glasses, or "log glasses," are made to run 14 seconds and 28 seconds (the former being for use when fast travelling, and the knots by line have of course to be doubled if spaced for 28 seconds). It must be remembered a nautical mile is 2,027 yd., usually called 6,080 ft. It corresponds with the minutes of arc; thus there are 360 × 60 = 21,600 of arc, or nautical miles, on a "great circle" (or the equator). The number of yards therefore in a "great circle" divided by 21,6 0 will give the number of yards in a nautical mile. In calculating the length of a knot in feet, the rule adopted is this. To the seconds run by the glass affix a cypher and divide by 6. The remainder when doubled gives the inches. Thus for a 28-second glass $\frac{280}{6} = 46 + 4$, or the distance between adjacent knots = 46 ft. 8 in. This is not correct, but the error is for safety, as the ship, unaffected by favourable currents, will be behind her position by log or "dead reckoning," as it is called. To calculate the exact length between adjacent knots on the line, multiply 2,027 by 14 or 28 and divide by 3,600. Fig. 1 is the wooden log ship; it is a wooden quadrant about ½ in. thick and 10 in. diameter, the arc being weighted with lead to make the log float vertically. The end of the log line L passes through a hole and is secured by knotting at the back, while a wooden peg P is attached to a span B from the line L. When the log line is suddenly checked in its running out, this wooden peg withdraws its hold in the quadrant, and the log ship is hauled in with ease. The canvas log is shown in Fig. 2. The log line is attached at D to the canvas bag C, at the mouth of which is a span seized to the peg at E, which is pushed into a wooden ferrule W seized to the log line; when the line is checked the peg withdraws as in the former case, and the bag closes, being hauled in bottom foremost. The "patent log," by which name the several revolving logs go at sea, is self-registering, and not hove at intervals as the former kind. A meter is clamped to the taffrail, showing on its face by three hands the units, tens, and hundreds of nautical miles run since the last setting, which is done at noon. This meter is a simple train of wheels to which motion is imparted by a threaded pin. At the back of the meter and attached to the pin is a brass universal joint J (Fig. 3), to which is secured the end of a line sufficiently long to clear the eddies and backwash of propellers, etc. At the other end is the spinner S, a three-bladed brass fan, pitched to revolve at such a speed that after being towed one mile the unit hand on the meter shall have made one revolution from 0 to 0, the intermediates being marked ¼, ½, ¾. Sometimes a light fly-wheel is attached to the line just abaft the taffrail, but this is not really necessary. Ball bearings between a cone collar on the shaft and a dished bearing in the back of the meter would be an improvement. Owing to the length of flexible line through which the revolutions are transmitted, the motion is a succession of spurts, but this, however, does not affect the correctness of distance registered in the twenty-four hours.

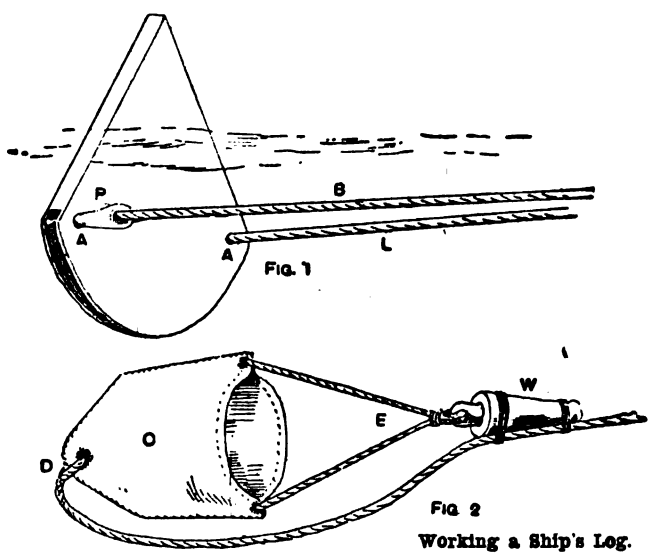


FIG. 1

FIG. 2

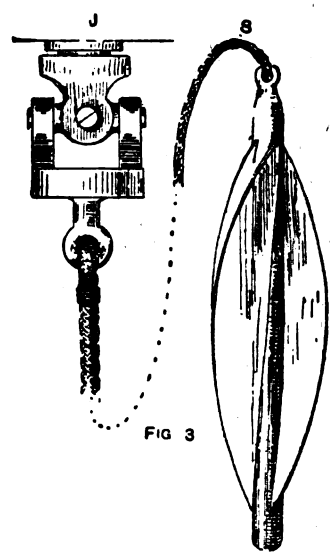


FIG 3

Working a Ship's Log.

Ingredients for Seltzogene Charges.—The charges for a 3-pt. seltzogene are tartaric acid 1 oz., and bicarbonate of soda 1⅛ oz. Any difference observable in the taste of the ready-charged syphons and of the water from the seltzogene using the charges purchased is probably due to the kind of water used, and also to the fact that a small quantity of carbonate of soda is added to the water in the syphons, whereas in the seltzogene there will be no soda in the water unless it be put in before filling the seltzogene.

Making Billiard Chalks.—To prepare green billiard chalks, mix together 5 parts of powdered magnesite and 1 part of china clay, and add 1 part of mineral green or terra verte; for a blue chalk, substitute 1 part of artificial ultramarine. Make the mixture into a very stiff dough with the least possible quantity of water, allow to stand for several days, roll it out into a cake of the thickness required, then cut it into squares with a fine wire; impress a hemispherical indentation on each square, then separate them and dry them very slowly—first in the air, then in a warm oven. If the squares are shaped in brass moulds the material should be made very stiff, almost dry in fact; the chalks will then be harder. If the chalks are too soft, add more china clay; the colour can be made to suit by trial.

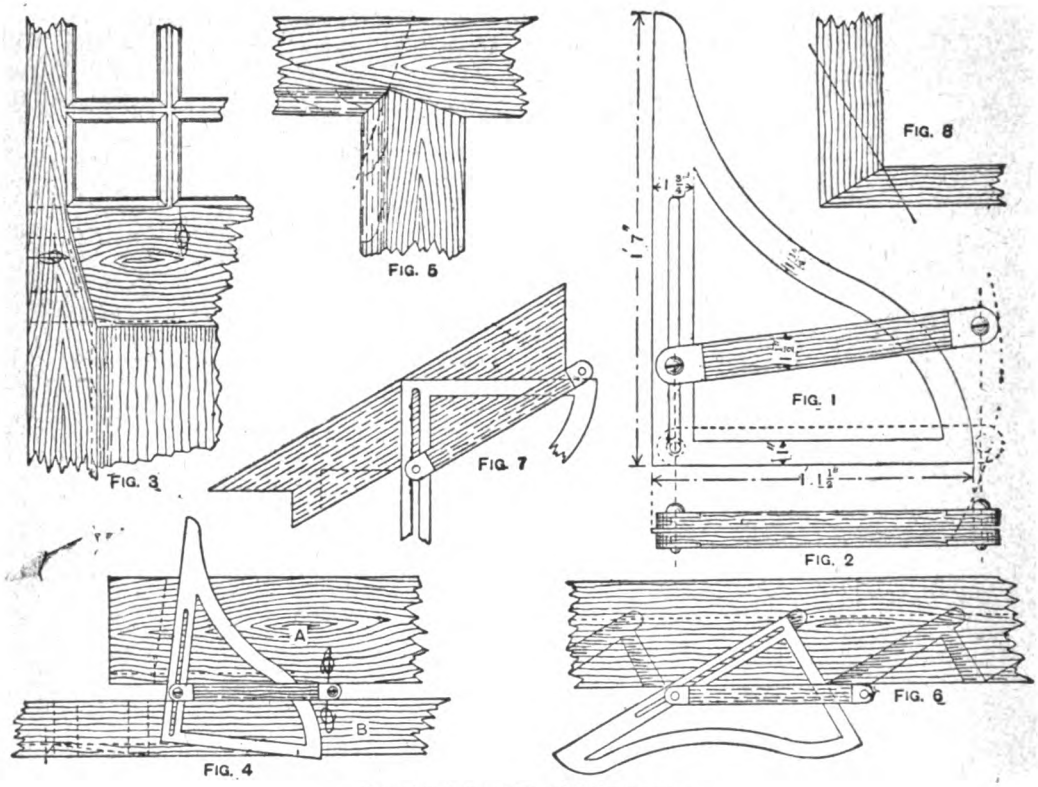
Renovating Old Oil Painting.—To restore to its original colour an old oil painting that is black with age and smoke, wash it with a sponge or soft leather and clean water, and dry with a silk cloth. If the painting is very dirty, take it out of the frame and lay over it a clean damp cloth. Allow the cloth to remain for a day or two, keeping it damp all the time. Then remove the cloth and place another clean damped one over the picture, and keep on renewing the cloths till the dirt is thoroughly soaked out of the painting, when it may be washed with a sponge and water. Then rub over the picture a little clear linseed oil, or give it a thin coat of mastic varnish applied with a clean flat brush till every part is covered, and set aside to dry where no dust will fall on it.

Converting Fat into Soap.—In converting a few pounds of fat into a good hard soap, dissolve 1 lb. of caustic soda in 3 pt. of water; then melt down 6 lb. of fat in an earthenware bowl. Bring the temperature of the fat to about 110° F., and the temperature of the soda lye to about 80° F. Now pour the soda lye very slowly into the centre of the fat and stir thoroughly with a stick, so that the lye becomes amalgamated with the fat as fast as it is poured in, and the two form a perfect emulsion. Now wet a large piece of cloth and place it in a box so that the whole of the wood is covered; then pour in the mixture just made, cover the box, and place it in a warm place for twenty-four hours. The soap is then ready to be cut up and used.

Cleaning White Marble.—To clean white marble that is much discoloured, make a thin paste with fuller's-earth and water to which has been added 25 per cent. of liquid ammonia. Spread this over the marble with a brush, allow it to remain twenty-four hours, then wash off. If all the stains are not removed, repeat the operation.

How to Make a Bevel Set-square.—Fig. 1 shows a side elevation of a carpenter's bevel set-square of suitable dimensions for setting out diminished stile doors constructed of plank widths; but a much smaller tool would be more handy for general purposes. The tool consists of two parts: a skeleton set-square made of steel or stout zinc, the former preferably, and an adjustable stock working in a slot which is about two-thirds the length of the long edge of the square. The stock is very similar to that of an ordinary bevel, except that it is in two parts which are connected at the ends by means of clamping set-screws, as shown in the end elevation (Fig. 2); it is applied. The tool can easily be changed into a perfectly true mitre square by fixing the stock at equal distances along both edges from the angle, or it can be used as an ordinary bevel. A wooden instrument based on the same principles is used by some joiners, but it is a clumsy article, and cannot be finely adjusted. The tool can be used as a set-square, or, by clamping down the stock in the position shown by dotted lines in Fig. 1, as a try-square.

Particulars of a 10-ft. 6-in. Split-cane Fishing-rod.—The handle of a split-cane fishing-rod, 10 ft. 6 in. long, which is to be made in three lengths, should be of cedar or walnut 16 in. long and 1¼ in. diameter at the largest part; butt, ½ in. diameter above the handle, tapering to fit a ferrule of ⅜-in. bone; total length of butt, 3 ft. 6 in. Second joint, ⅜ in. diameter at the counter, tapering to fit a ¼-in. ferrule at the top; total length, 3 ft. 6 in. Top, ¼ in. diameter at the counter, tapering to 1/16 in. at the point; total length, 3 ft. 6 in. The number of pieces in each



How to Make a Bevel Set-square.

the tool can thus be adjusted to almost any position. Fig. 3 is a part elevation of a diminished stile door, shown in order to explain the application of the tool in setting-out the shoulders of the joint. This is shown in detail at Fig. 4. The dotted lines on the part A are the setting-out lines for the rail, and those on the part B are the setting-out lines for the stile. Figs. 3 and 4 should be compared. The rail and stile are shown separated in the sketch for the purpose of illustrating the method of using the square. Fig. 5 shows another joint where the tool can be applied with advantage. Fig. 6 shows the tool being used as a pitch-board; it can be worked from either edge of the string, and although it does not do away with the wooden pitch-board itself, no sliding slip is required, while its thinness and metal edges enable a much cleaner job to be made with the striking-knife. Fig. 7 shows the tool applied to roofing. A number of rafters can be laid side by side, and the length squared across them with a line at both ends. The stock of the square is then set to the pitch of the roof, and both bevels are obtained at once; no awkward moulds require to be lifted up and down, and both the bevels and the square are comprised in the same instrument. Fig. 8 shows a mitred joint of two different thicknesses of wood; the thick lines show the edges of the square when

part will depend on the thickness of the cane; but the butt may be built up with six segments, each one made up of two thicknesses of cane, making twelve pieces in all. The second joint and the top should each be made with six pieces of cane. A good iron-faced plane, file, piece of glass, brace and bits, hammer, and glasspaper are the tools actually required.

Making an Enlarged Photographic Negative.—Any of the methods employed for making a bromide enlargement may also be used for making an enlarged negative, that is, by replacing the small negative by a positive transparency and enlarging this on to an ordinary dry plate. For cheapness, and with some subjects, bromide paper may be used for such transparency, developing rather dense with a strong but well-restrained developer, and, when dry, waxing the print and heating over a lamp. The best kind of transparency to use is one by the carbon process, as these are most free from grain and give the best gradation. As the emulsion used on dry plates is considerably quicker than that used for bromide paper, and is consequently more liable to fog, it is advisable to use an enlarging camera where the plate is enclosed in a slide. Enlargements are best made by daylight, otherwise there is a tendency to hardness.